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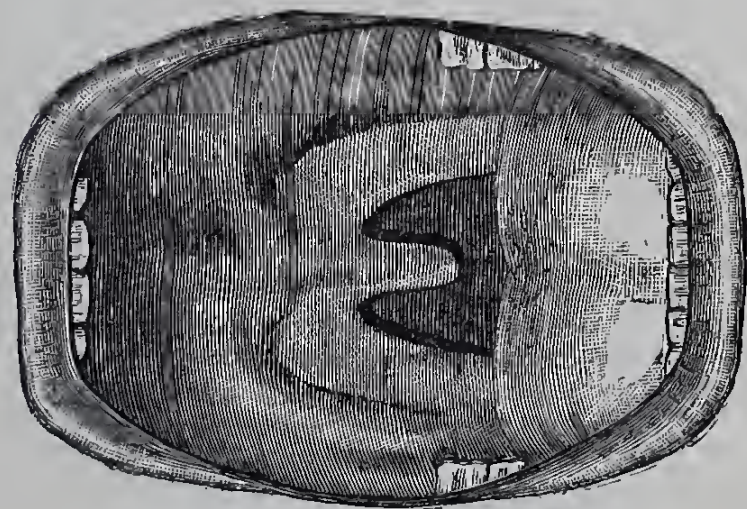


FIG. I.

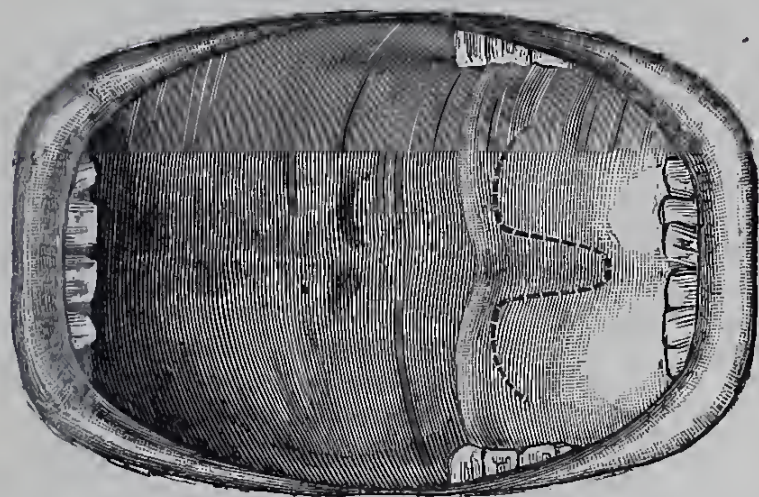


FIG. II.

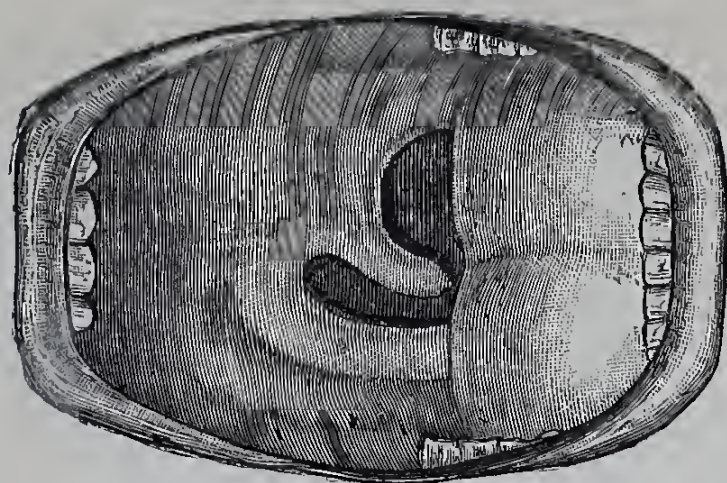


FIG. III.

EXPLANATION OF FRONTISPIECE.

FIG. I. Typical representation of healthy fauces.

FIG. II. Bilateral paresis of palate, showing obliteration of superior arches, and drooping of the entire velum. The dotted line represents the position of the lower arch of the palate and the uvula, seen only when the tongue is firmly depressed.

FIG. III. Unilateral paresis of palate, showing obliteration of superior arch of palate, and drooping of the palate veil, on the affected side. The uvula is drawn to the healthy side.

Note.—The comparative recognition of the conditions depicted in these drawings will enable the observer to judge of the condition of the patient's vaso-motor system, as regards tendency to paresis, or otherwise; it will also afford similar indications concerning the muscles of the Eustachian Tube, *vide* ch. iv.

ON
DEAFNESS, GIDDINESS
AND
NOISES IN THE HEAD

BY
EDWARD WOAKES, M.D. LOND.
SENIOR SURGEON, AND SURGEON TO THE EAR DEPARTMENT AT THE HOSPITAL
FOR DISEASES OF THE THROAT AND CHEST

SECOND EDITION, ENLARGED AND REVISED

WITH ILLUSTRATIONS

LONDON
H. K. LEWIS, 136 GOWER STREET. W.C.
1880

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BY HIS FORMER PUPIL AND DRESSER
THE AUTHOR.



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PREFACE TO THE FIRST EDITION.

IN collecting for the following pages these studies of certain phenomena attending disease of the ear and its allied organs, two principal objects have been kept in view by the author. The first of these has been to examine the various conditions, competent to give rise to the symptoms in question, in order to assign each to its respective causes.

At the outset of this undertaking it was evident that very scant assistance was to be obtained from aural text books, because in confronting every obscure problem associated with the etiology of Giddiness and Noises in the Head, one explanation was invariably made to do duty for all, that, viz., of referring them to some *subjective* state of the auditory nerve.

To attempt to recover the subject from this ambiguous position, it became necessary on theoretical, but especially on practical grounds, to examine it from a point of view unoccupied by previous observers.

About ten years ago, while considering the association of neuralgia with herpes, and the analogous phenomena attending wounds of nerves, the author became aware that in numerous instances in the economy, the local connexions of vaso-motor innervation are such, that given tracts of tissue, not otherwise connected, are thereby habitually kept in nutritive correlation one with another. Between any two areas thus correlated so intimate is the relation

that any departure of one of them from its ordinary **state** is immediately appreciated by a corresponding set of nutritive changes in the other. The explanation of this mutual interdependence between the respective, often widely separate, regions, is found in the association of their afferent and efferent nerves with a given sympathetic ganglion. Thus, these organs were seen to assume co-ordinating functions not usually attributed to them.

The tentative application of this theory to elucidate certain natural physiological processes, as also others occurring in disease, appearing to afford satisfactory results, it remained to make use of it for the purpose of explaining the origin and method of production of Tinnitus and Vertigo. The endeavour to do this constitutes the second object prominently before the author in the work now published.

A considerable portion of the material of this treatise has appeared at different times in the pages of the medical journals; in collating it for its present purpose diagrams have been added to illustrate the text. The author is indebted to the artistic skill of his friend Mr. Edward Bellamy for those illustrating the more obscure anatomical references. It will be understood, however, that these diagrams are intended to indicate existing anatomical relations, rather than accurately to define them.

Undertaken as these studies originally were for the author's own instruction, he has aimed at imparting to their publication in the present form such a practical value as may render them of service to others interested in the subject of which they treat.

57, Harley Street, W.
January, 1879.

PREFACE TO THE SECOND EDITION.

THE first edition of this work having been exhausted in a much shorter period than the author had any reason to expect, he is desirous in this second issue to add to its usefulness, and to obviate some of its former defects.

In view of both these objects, he has freely availed himself of the suggestions of his Reviewers. To these gentlemen, whether at home, on the Continent, or in America, he would express his acknowledgments of the uniformly forbearing spirit in which they have exercised their literary function.

By means of the newly added matter the author has carried on the Natural History of Deafness from a causative point of view. Under this head two new chapters have been added, with the purpose of continuing the Etiology of Deafness beyond the periods of infancy and childhood, to which, in the first edition, his remarks were limited, and extending it through the ages of adolescence and adult life. He has not proposed in this connection to give an exhaustive *résumé* of all the causes which deteriorate the hearing power, but has confined his remarks to such as, in his experience, are most frequently operative during each period of life.

Whether this scheme will prove an advance in the study of aural diseases may be an open question, its

adoption here is the outcome of the application to otology of the principle laid down in the preface to the first edition, that, viz., of tracing trophic tissue changes to their source in the vaso-motor system.

An additional sympathetic ear-symptom, that of *Ear Sneezing*, is examined and traced to its physiological and anatomical factors.

The part enacted by the inferior cervical ganglia in producing *Giddiness*, or in giving rise to distant symptoms associated with this condition, has received further elucidation. Also, the local changes in the auditory apparatus which conduce to this effect are examined.

The phenomena of *Noises in the Head* have also been studied anew, and with such further assistance as the author's enlarged opportunities of observing the disease have placed at his disposal.

57 Harley Street, W.

May, 1880.

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ERRATA.

Page 154, *parag. 2, line 2*, for "cause of phenomena" read "cau
the phenomena."

„ 181, *after* "camphor wool" *insert* "camphor 3j."

„ „ *7th and 8th lines, and last line but one, for* (s. p.) *read* (s

„ 183, *after* "salicylate of soda wool" *insert* "cotton wool 3j."

ON
DEAFNESS, GIDDINESS,
AND
NOISES IN THE HEAD.

CHAPTER I.

SOURCES OF EAR AFFECTIONS IN INFANCY AND CHILDHOOD.
DENTITION. EAR COMPLICATIONS OF DENTITION A
CAUSE OF INFANTILE CONVULSIONS. EAR AFFECTIONS
DEPENDENT UPON DISEASES OF THE TEETH.

BETWEEN the ear and some more or less adjacent organs there exists a large amount of so-called sympathy, a circumstance that is continually giving rise to symptoms of an anomalous and unexpected nature, which oftentimes assume the gravest possible import involving even the issue of life and death. These symptoms, from the obscurity which surrounds them, have met with too much neglect, although their intelligent appreciation, appears indispensable to the proper treatment of the commonest types of disease. By adjacent organs I do not simply refer to the nose or the throat, for as will shortly be seen, the grasp of our subject extends to the stomach, the arms, the brain, the larynx, and in fact to various unexpected regions.

The field of inquiry thus opened possesses interests far beyond those which appertain to the ear as an organ of special sense. Even from this narrower point of view,—the possible loss of hearing as the result of destructive processes in the ear occurring as complications of infantile ailments,—the issue is one of grave anxiety. For a child who thus becomes deaf before it has learnt to talk will be dumb also, producing the pitiable object of an intelligent being deprived of two channels of communication with the outside world.

As already intimated it is on the very threshold of life that these sympathetic ear symptoms are brought into prominence. A child is cutting its teeth, and while the gums are yet swollen it suffers acutely from earache. How do we know this, seeing the child cannot speak? Anyone accustomed to watch carefully the symptoms of these little patients will scarcely fail to discern in the troubled face, the resting of the head on the nurse, the thrill of agony which passes across its features accompanied with piteous cries or shrieks when its position is moved, especially if this be done suddenly, and more than all the constant raising of the little hand to the side of the head,—no one who has watched these symptoms will fail to connect them with the most agonising of all the sufferings of early life, *earache*.

Now the point which I wish to emphasise is this: the pain thus experienced, is not what we vaguely call neuralgia; it is a definite trophic change, an inflammation taking place in the deeper-seated tissues of the ear, beginning with congestion and stretching of an acutely

sensitive region, passing on to exudation and suppuration, and capable of being recognised if the proper means are used for doing this. If the case be seen early all these symptoms are at once removed by a free incision of the swollen gums. But it often happens that those trophic changes just alluded to have set in before the practitioner is called upon to see his patient. The gums are, however, duly lanced, and very properly so, because reflex irritation, a term I shall presently more fully explain, is thereby lessened. But to the disappointment of practitioner and parents the little patient is not cured. Then commences the orthodox rôle of treatment. Cold to the head, hot baths, mustard plasters, and perhaps a calomel purge, followed by enemata. Still the patient gets worse, convulsions set in and the child dies. Meanwhile the organ really affected, *the ear*, has perhaps not been thought of as a factor in the case, while the inflammatory processes taking place in it have extended to the brain or its membranes, an occurrence for which every facility is arranged by the intimate communications which in the infant especially, exist for such an issue. Or it may happen that suddenly the symptoms abate and the child is well; a little discharge takes place from the ear, which is perhaps unnoticed; or the friends say an abscess has broken in the child's head during the night, and, usually no more is thought of the matter. Perhaps the practitioner does not believe in "abscesses in the head," and ignores it altogether. Should the discharge continue and his attention be called to it, he is careful to inform the friends of the danger attendant

upon checking such a useful derivative ! At any rate the disease is let alone. Meanwhile, the middle ear of the patient is undergoing suppurative inflammation ; its delicate textures are breaking down, and soon irreparable mischief has been accomplished. Happy is it for the child if one ear at least have escaped, which fortunately it often does. Otherwise the child will be deaf, and as a consequence dumb also. This is no fancy portrait evolved out of the inner consciousness of the writer. It is one that I have often seen, and those who are accustomed to aural out-patient work will support me in the statement that the condition I have sketched, one of advanced disorganization of the middle ear in children, for which no cause can be assigned, furnishes a large proportion of the cases of deafness that come before us for treatment in that department.

But a child has by no means escaped ear trouble arising from the teeth, if it have safely passed over the period of their evolution. Professor Böke, of Pesth has distinctly traced external otitis in children to the presence of a carious tooth ; and even in later life a decaying tooth will indicate its presence by prolonged earache, and even will establish an otorrhœa. Mr. Hilton records such a case in his classical work on " Rest and Pain," and the recognition of such cases will doubtless be more frequent when the possibility of the association referred to is more generally recognised. I give Mr. Hilton's example, as it is typical. " A professional friend " he tells us, " had an enlarged gland below the external ear. The real cause of this was not quite

apparent, and so he requested me to look at it. There was a slight discharge of morbid secretion in the auditory canal. We argued the case together, I said, 'very likely it may be the result of a decayed tooth. Irritation from it may be conveyed to the auditory canal, and induce this morbid secretion; that morbid secretion may produce slight excoriation, and that excoriation, aided by lymphatic absorption, may explain the existence of the enlarged gland.' The tooth was extracted, all the other local morbid conditions disappeared, and there was no recurrence of the local symptoms."

Now the question before us is to find the solution of the train of symptoms just detailed. We have the phenomena of pain, inflammation, and suppuration, occurring in an organ widely separated from the recognised exciting cause, and in tissues histologically distinct from those manifesting the morbid changes. The only obvious connecting link between the regions interested is the continuity of nerve fibre. The simple continuity of sensori-motor nerves is insufficient to produce the conditions under review, we must seek yet farther for the true medium by which they are brought about. This will be found in the relations of the vaso-motor nerves, and the functions which it is their office to fulfil.

As it is this portion of the nervous system, that is mainly concerned in the morbid processes we are examining, it will be necessary briefly to enumerate the chief points in its economy. By far the most important fact in connection with the vaso-motor system is, that with one or two exceptions, all sensori-motor nerves

comprise fibres belonging to it, and that these fibres run in a contrary direction to the cerebro-spinal nerve with which they are associated. Thus in speaking of a cerebro-spinal nerve, say the vagus, we describe it as pursuing a course *from* the medulla to the respiratory organs, and the several viscera which it supplies. At the same time it must be remembered that it contains other febrillæ in its sheath running *from* the viscera towards the nerve centres, some of which at intervals leave the sheath and enter a ganglion of the sympathetic, in their course to the general vaso-motor centre, situated in the medulla oblongata, at a point which has scarcely been determined for the human subject, though it has been accurately fixed in the rabbit. These fibres then are centripetal or afferent in their function, conveying impressions from the tissues to the sub-centres constituted by the ganglion, or to the general vaso-motor centre. When these fibres enter a ganglion they communicate with its caudate cells, which important fact brings them into communication with other nerves coming from very different directions, to the same ganglion. When the afferent fibres leave the ganglion, they pass backwards by one of the two cords leaving the ganglion to join the spinal cord, and in it traverse the anterior columns of the cord in an upward direction to reach the primary vaso-motor centre.

The *effluent* or *centrifugal* fibres in reflex relationship with the foregoing, follow an exactly similar course from the general centre *downwards*, likewise along the anterior columns of the cord, which they leave opposite an inter-vertebral foramen to join a sympathetic gang-

lion, constituting its second root, and after similarly mingling with the caudate cells, quit it to seek their several destinations on the coats of the arteries whose calibre they regulate. Further, it is to be noted that by the automatic action of the *general* vaso-motor centre, the normal calibre or tone of the vessels is maintained.

As the result of the study of numerous morbid conditions involving the vaso-motor apparatus, I have been led to conclude that the sympathetic ganglia not only play the part of secondary centres or sub-centres, receiving and transmitting impressions quite independently of the general centre; but that they are also *correlating organs* by means of which afferent tissue impressions from one direction are reflexly referred to a totally different tract; the afferent impressions being manifested through their medium as efferent impulses in the area to which they are thus reflected. In other words, the sympathetic ganglia are so many stations situated on the lines traversed by vaso-motor impressions, in which the "points" so to speak, are managed, and by means of which impulses are transferred from one line to another.

There is one other inference that appears to be borne out by the facts now under consideration, viz., that the numerous ganglia distributed about the branches of the fifth and other cranial nerves, do really belong to the series of the sympathetic ganglia proper, and that they subserve the same function of deflecting from their ordinary path any strong impression that may reflexly pass through them.

Now when a vaso-motor impression proceeds in the

manner just sketched, from the nerves involved in some morbid process going on in a given part, it usually declares itself by a dilatation of the vessels in the region or area to which the impulse is communicated, thus allowing the vessels of this region to become greatly distended with blood. To such an extent will this dilatation proceed, that the quantity of blood pumped into the relaxed arteries, may be 10 times as much as would flow through it when the vessel concerned is in equilibrium. The various tissues intervening between the seat of the exciting cause, and the locality to which the dilating wave has been reflected, are in the meantime, quite free from any abnormal manifestation.

Following the cycle of events consequent on such a reflexly excited impression, we find a series of trophic tissue changes commencing in the correlated area. To these I shall devote a passing glance, in order the better to understand the analogous conditions in sympathetic or reflex affections of the ear. They are admirably illustrated in the secondary lesions following gunshot wounds of the brachial plexus, to which typical example of reflex vaso-motor phenomena I shall have frequent occasion to refer. To comprehend the *modus operandi* of the ultimate issues of such an accident, (wounds or contusions of the brachial plexus), it is necessary to anticipate the statement, to be further insisted upon later on, that the subclavian artery and its branches receive their *nervi vasorum* from the inferior cervical ganglion, so that these vessel-nerves, which follow the arteries to the arm and hand, are the efferent cords in

reflex relationship with the afferent vaso-motor fibrillæ, associated with the nerves of the brachial plexus. Thus it will be seen, that into this sympathetic ganglion, the vaso-motor fibres proceeding from the arm enter before joining the spinal cord to reach the general centre; and that through it also pass the fibres descending *from* the centre, and destined for distribution on the vessels of the limb; and further, from it proceed the fibres constituting the inferior cardiac nerve, as also other branches possessing, as will be afterwards shown, regulatory powers over the circulation of distant and important areas. Thus it will be seen how—to revert to the former illustration—the inferior cervical ganglion constitutes the station for the management of the “points” belonging to this section of the system. It is, moreover, of interest to note that while the injury may have been received high up in the limb, the consequent variations of tissue nourishment are in these cases, produced in their most marked degree in the extremity of the injured member—*i.e.*, at the peripheral distribution of the vessels whose calibre is regulated by the nervi vasorum in reflex relationship with the injured trunks.

Since Sir James Paget first called attention to this group of phenomena they have been noticed by numerous observers. They occur in all degrees of intensity, from a papular rash along the side of the forearm following puncture of the median nerve, to those extreme degrees of lesion which follow gunshot wounds of the brachial nerves. In these latter the *hand* witnesses quite extraordinary changes. Here are found eczema,

herpes, atrophy of skin and muscles, blotches of congestion, local ulcers, wasting and curving of the nails, intense neuralgia, accompanied with such complete contraction of the joints of the fingers and the wrist, that a peculiar claw-like appearance is imparted to the hand, very characteristic of these injuries.

We cannot stay to trace out the steps leading to each of the conditions just mentioned,* it being sufficient for our purpose to state that the symptoms in question are established by impressions proceeding from the injured vaso-motor fibres accompanying the spinal nerves, and reflected from their centre to the *nervi vasorum*, and to the direct consequences of these reflected stimuli on the calibre of the vessels to which they are distributed.

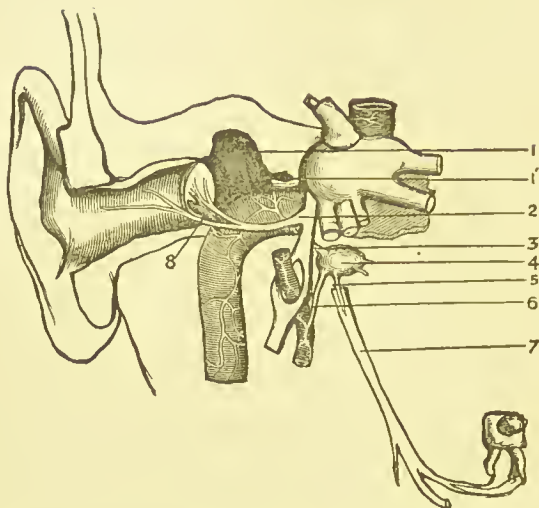
These, and many parallel facts, supply the data by which to arrive at the true method of explaining obscure sympathetic symptoms. I have formulated the conclusions arrived at in the following axiom:—In the first place it is necessary to trace the source of the *nervi vasorum* supplying the vessels of the structure sympathetically, or rather reflexly, affected; then ascertain their association with the vaso-motor nerves proceeding in an afferent direction from the tissue in which is seated the original lesion. This association will be found to consist in a communication of twigs from the vascular nerves with a ganglion, while the nerve proceeding to the region primarily affected will be found in connection with this ganglion.

* The reader who may be interested in this subject is referred to the final chapter of the vol. for further details respecting it. The material and facts there given were first published by the author in an article in the *Jour. of Cut. Med.*, 1867.

Guided by the principles now briefly reviewed, we may return to the study of those special ear cases already referred to; those, viz., of congestion and inflammation of the auditory structures arising from the irritation of teething, or in later life from the presence of a decayed tooth. Here it will be desirable to premise that aural authorities are singularly unanimous in discarding otalgia, *i.e.*, neuralgic ear-ache from the catalogue of affections of the ear as a distinct entity—observing that when diligently searched for, this symptom will be found associated with a hyperæmic condition of the drumhead, or some contiguous region; and in this conclusion my own experience leads me to concur. We have, therefore, to ascertain how a congestion of the ear, sufficient to give rise to the severe pain, can be caused in a reflex way by irritation connected with the teeth and gums.

A considerable portion of the blood-supply of the membrane of the drum is derived from an artery that leaves the internal carotid in the carotid canal, and proceeds by a very short course directly to its destination. Being thus closely connected with a large arterial trunk, this small *tympanal branch* (*vide* diagram, fig. 4, 8) of the internal carotid artery possesses very favourable circumstances for a speedy augmentation of its blood-supply. Now the nervi-vasorum constituting the carotid plexus at this part of its course come largely from the otic ganglion (fig. 4, 3). The third br. of the fifth nerve is cut through in the diagram to show this ganglion. On the other hand, the inferior dental nerve (fig. 4, 7), supplying the decayed tooth or

FIG. 4.



1. Tympanic Cavity.
2. Auricular br. of auriculo-temporal nerve.
3. Br. fr. otic gangl. furnishing vascular nerves to internal carotid artery and its branch the tympanic art.
4. Otic ganglion.
5. Br. fr. otic ganglion joining inferior dental nerve.
6. Middle meningeal artery.
7. Inferior dental nerve to teeth and gums.
8. Short tympanic branch of internal carotid artery.

gums, as the case may be, also communicates with this ganglion, (see fig. 4, 5). We thus arrive at a direct channel of nerve communication, through the otic ganglion, between the source of irritation, the tooth, and the vascular supply of the drum-head. The effect then of the irritating impression proceeding from the decayed tooth or swollen gums, will be to excite waves of vessel dilatation in the correlated area, the drum-head. Its vessels now become largely distended, acute

congestion is thus established with its attendant stretching of the sensitive and tense tissue in which it occurs, and so occasions the pain experienced by the subject of these conditions. If the irritation be sufficiently prolonged, effusion into the tissues ensues which, under favourable circumstances will pass on to suppuration, and constitute a veritable otorrhœa.

Owing to the free inosculation of the vessels of the drum-head with those supplying the tympanic cavity it will not be long ere this region participates in the inflammatory process, so that this cavity may also become filled with pus or muco-purulent fluid. Should the accumulation not escape by the Eustachian tube, which, from its comparatively larger size in infancy, it is very likely to do, it will press the drum-head outwards, causing it to bulge, while a similar pressure will be exerted upon the membranes closing the foramen ovale and foramen rotundum on the inner wall of the cavity, producing thereby a state of tension of the endolymph and compression of the fibrillæ of the auditory nerve sufficient to produce convulsions. Apart from this pressure, however, the pain already experienced would be sufficient to give rise to this symptom by the irritation it excites in the sensitive cerebral centres of the infant.

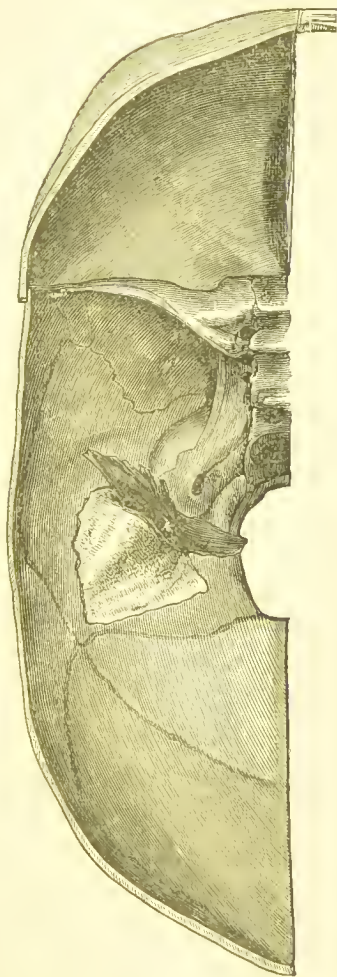
Even before suppuration has been set up, there is great danger of the inflammation extending to the membranes of the brain from certain structural arrangements already alluded to, and to which I wish to draw special attention. The dried preparation of an infantile cranium, from which the accompanying

illustration is taken, is particularly well calculated to indicate one of these sources of danger. It is constituted by the petro-squamosal fissure, at the line of junction of the petrous with the squamous portions of the temporal bone, which are developed separately; the division being exceedingly well marked in the preparation. At this fissure the dura mater dips down into the cavity of the tympanum, becoming continuous with its muco-periosteal lining. This process of dura mater carries with it a rich endowment of vessels derived from the middle meningeal artery, and which are the vessels proper to the cavity. In the progress towards adult life this fissure becomes more or less obliterated, though the vascular connection with the arteries remains.

From these various anatomical considerations, and there are others pointing in the same direction, the conclusion is obvious, that when brain symptoms develop themselves in an infant, it is to the *ear* that attention should be primarily directed. We have seen how readily during teething congestion and inflammation may arise in the drum-head, how by continuity of vessels this may spread to the cavity of the drum, and how this latter condition so readily becomes meningitis.

As regards the frequency of ear diseases in young children, it is as I have already said much greater than is ordinarily believed. Out of 80 infants under 14 months, examined by Dr. Wreden of St. Petersburg, more than 80 per cent. had some form of ear affection. Von Tröltzsch in calling attention to this fact reflects severely on the practitioner who sees in all brain symp-

FIG. 5.



Represents a dried preparation of infantile cranium, interior, the dura mater has been stripped off the outer half of the petrous process, showing its continuity with the tympanic cavity, at the petro-squamosal fissure. The point of continuity is marked with an asterisk [*]

toms exhibited by children, during the period of dentition, the dental aspect of the case only. In taking this view it would seem that Von Tröltsch falls into the tendency of every specialist, who sees the case only from his own standpoint. The broader aspect of the subject developed in the preceding remarks is, I venture to submit, the more correct one, and it has the merit of physiological fact for its basis. Its true importance can only be realised by the fullest recognition of those sympathetic relationships of the ear established through its elaborate nervous connections, one of the most important of which we have been studying. When these relationships are fully grasped the twofold meaning of the symptoms will be apparent, and while not neglecting the teeth, the *fons et origo mali*, the practitioner will direct immediate and earnest attention to the more vital organ, the ear, which is now involved in the disease.

In *treating* an infant, the subject of inflammation of the ear, an object of primary import is to secure for it a comfortable posture. This is best done by placing it on a large pillow across the knees of the nurse, who must be enjoined not to rock it, as every movement will aggravate the patient's suffering. The head may be raised somewhat by a small horse-hair cushion placed under it. The room should not be very light, it should be free from noise, and the temperature cool. The affected ear which will usually correspond with that side on which the gums are swollen, should be uppermost, It should be fed with a spoon, as the act of sucking increases the pain. Attention to these details

will add greatly to the ease of the sufferer, and in proportion promote recovery.

I take for granted that the gums have been lanced, supposing that indications for this proceeding are present. Those who have followed the physiological observations already made, will understand the importance of this step, as thereby the waves of irritation proceeding from the gums to the vessels of the ear are stopped, and the dilatation of these vessels consequent thereon will gradually subside, that is, if no trophic changes have already commenced.

This observation will serve to indicate the sense attached in these pages to the expression *reflex-irritation*. It means a definite vascular condition, usually though not necessarily one of dilatation, originating at a greater or less distance from the scene of vessel disturbance, and propagated by vaso-motor nerves in the manner described. This notion of the term in question, will assist in getting rid of some of the vagueness frequently surrounding it when applied to the trophic processes of disease.

I assume, that by this time an examination of the drum-head of the patient will have been made, a proceeding which by the exercise of a little tact, and with the aid of the appliances, the use of which will shortly be explained, should not be difficult to accomplish. The appearances now evident will be as follows; the pearly lustre of the membrane will be exchanged for one of redness, owing to the injection of the vessels of the membrane, and occasionally, if its transparency be not impaired, and the disease have advanced so far,

the lining membrane of the cavity of the tympanum will appear red also. These conditions when visually present, should satisfy the observer that a very grave state of things is before him, a gravity that will impress itself upon his mind the more forcibly, if he remember the continuity between the tissues lining the tympanal chamber of the dura mater of the cranium, and also the continuity of the vessels entering with it into the inflamed region.

It should by this time be perfectly clear to the reader, that *ear-ache*, under whatever circumstances it may occur, is never a trivial accident, to be treated with a boiled onion or warm oil,—or otherwise slightly to be regarded—as is too frequently done by those who regulate the therapeutics of our nurseries. I am more and more convinced that many obscure and often fatal illnesses in children, which from their affinities are regarded as acute cases of hydrocephalus, or brain fever, would, if examined from an aural point of view, be found either to originate in this organ, or be due to its implication in a reflex way; and I cannot too strongly insist on the importance of such an examination being made whenever brain symptoms arise and the cause of them is doubtful, or in any respects obscure. Confirmed in the diagnosis by actual inspection, we shall pursue the treatment with less hesitation.

The next measure should be the *abstraction of blood* from the ear. This is best accomplished by the application of two leeches within the concha, a little plug of cotton-wool being first neatly inserted into the meatus, to prevent blood from trickling into the canal.

There need be no difficulty in this step, but if circumstances prevent the spot indicated being adopted for the purpose, the space in front of the tragus or behind the ear may be selected instead. Whatever may be thought of bleeding generally, there can be no doubt that acute inflammation of the auditory apparatus imperatively demands the abstraction of blood. Whether we regard the confined space in which the process goes on, the rapidity with which the disease passes to destructive stages, or the neighbourhood of vital organs which are readily implicated—any or all of these considerations should satisfy the mind of the practitioner that the case before him admits of no hesitancy in the use of measures that will cut short the disease.

At the same time drop doses of *Tr. aconit.*, B.P., should be given, because it diminishes the heart's action and lessens the sensitiveness of the peripheral nerves.

After the bleeding has ceased, the plug of wool should be carefully removed; rather warm water should then be gently run into the external canal (it may be squeezed from a small piece of sponge) and this should be renewed at frequent intervals. This simple application is more soothing than any other. Poultices should be avoided as they promote suppuration. Bromide of potassium, gr. iij, should follow.

The foregoing treatment, if commenced under the conditions given, will cure the patient in a comparatively short time.

Should the symptoms continue either from the case

having advanced beyond the congestive stage before being treated, or if the child be strumous or syphilitic, or the subject of some other dyscrasia favourable to the rapid formation of pus, it will be necessary to make a very careful examination of the drum-head, for indications of distension. It is probable that throughout the case some convulsive conditions, as just intimated, will have existed, such *e.g.*, as the thumbs being turned into the palms of the hand, the great toes being tightly adducted, and occasional startings of the entire body. These may be regarded as due to disturbance of the sensorium from the febrile condition, and though they must not be lost sight of they have not that grave import which attaches to others, which may supervene. One of the most suggestive of these is rolling of the head from side to side, because to my mind it points unmistakably to labyrinthine mischief. By this I mean that the expansion of the auditory nerves in the internal ear, has become a participator in the disease, to the extent of disturbing the equilibrating apparatus, of which the semi-circular canals form a part. The fact that this organ of equilibration, constituted by the semi-circular canals, is an integral part of the auditory apparatus, gives to the diseases of this region an interest extending far beyond the conditions of deafness only. . And, as we shall see later on, many distant organs are capable of influencing it.

This symptom, *rolling of the head from side to side*, I regard as the counterpart of *vertigo* witnessed in later life, when the intrinsic circulation of the labyrinth is deranged, or its contents are pressed upon from with-

out, as in Menière's disease. *Why* the disturbance of the equilibrating organ should find expression in these semi-rotatory movements has not, so far as I know, been explained. In connection with this symptom, the following observations occur to me as containing a possible explanation of it: the faculty of co-ordinating muscular movements which is largely regulated by the semi-circular canals, is one that is developed by slow degrees, *pari passu* with the growth of the child; its influence extends from above downwards, being first manifested in the muscles which move the head. Those who have watched this muscular control developing in a very young infant will support the assertion that it is first exercised over the motions of the head; that while the hands are moved vaguely to seize an attractive object, the head is turned towards it directly and with precision. The lips of the child are its first prehensile organs, and the earliest efforts of muscular co-ordination are exercised to guide these to the sources which supply the means of subsistence. Thus it happens that the muscles of the neck are the first which are trained to act in concert, and being the only ones that do so in very early life, it is reasonable to expect that any disturbance in the organ which regulates this co-ordination should declare itself most markedly where it is most in force. In older children affected with grave lesion of the internal ear, *sobbing* has been noted to occur. It will be remembered that this is a constant symptom in recognised labyrinthine disease in adult life. I wish to insist on the crucial meaning of these symptoms; they guide us to the real seat of the mis-

chief—the ear, which unfortunately is the last region thought of in connection with the symptoms. Be this as it may, this rolling of the head should at once arrest attention. It may mean simply that pressure is being exerted on the contained fluid, or it may imply that the morbid process has extended through the membranes closing the orifice of communication with the middle ear, and has thus gained access to the auditory nerve. This symptom is perhaps the last note of warning that will present itself in time to be of service. If relief be not now afforded, paralysis and coma will shortly place the patient beyond our reach. This relief is to be procured by incising the membrane of the tympanum in the manner to be shortly described.

Before resorting to this proceeding,* it will be right to see that the Eustachian tube is pervious, and that the nasal passages are free from mucus, as also the post-nasal space. For it is to be observed that the indications of accumulations of fluid in the middle ear are of most frequent occurrence in the exanthemata, where the post-nasal regions are largely involved in the disease. In the instances of simple reflex otitis from teething which have occupied so much of our attention, the danger is rather from extension of congestion or inflammation to the brain—the type of the disease being more decidedly sthenic in character, and likely, therefore, to yield to those therapeutic measures already detailed. It is not probable, therefore, that in these cases puncturing the drum-head would be called for, or if indicated would succeed in saving the patient, as, before the formation of pus occurred, mischief would

have advanced intercranially, and matter would be found there concurrently with its appearance in the ear. Nevertheless, though not *likely* to be called for, the possibility of operative interference being demanded should not be lost sight of even here, as it holds out one more chance of saving life. Certainly if the doubt arose, the patient should have the benefit of it, the more so as the proceeding, if properly executed, can do no harm.

CHAPTER II.

SOURCES OF EAR AFFECTIONS IN INFANCY AND CHILDHOOD; EAR COMPLICATIONS IN THE EXANTHEMATATA.

As intimated in the preceding chapter, it is in the *exanthematous diseases* of childhood as well as in those of later life that the practitioner is most frequently brought face to face with the emergency of puncturing the drum-head; while the interests of truth compel me to add that scarcely is it realised once in a hundred cases. The lamentable neglect of ear complications in these diseases arises from two causes, the fact, viz., that aural specialists as a rule have very little opportunity of seeing them, while the family physician usually ignores *ears*, and therefore does not recognize the meaning of what is going on in these organs in exanthematous patients. In support of this assertion it will suffice to quote the following incident which occurred while these pages were in progress:—A lady, a deaf patient, asked my opinion of her brother's condition. It appeared that he was suffering from typhoid fever, and in reply to her very anxious enquiries respecting his progress, was informed by the medical attendant that he "must be going on well *as he was getting deaf!*" a kind of non-sequitur which carries its own comment: its absurdity was shewn in this instance by the fatal issue of the case.

My own experience of these diseases including some four or five epidemics of scarlet fever, and the usual amount of measles, small pox, &c. has afforded the opportunity of observing a number of such patients dying with symptoms which I now know to be distinctly *aural* in their origin, but respecting which the text-books give no clue. The comprehensive term "oppression of the sensorium due to intensity of the blood-poison" serving to include most of these conditions which a more exact analysis proves to have their origin in lesions of the middle ear, and the extension of the morbid processes to the meninges; to embolism, thrombosis, or pyæmia, all alike arising in this locality. It will scarcely, therefore, be matter of surprise that one has come to look with very great suspicion on that unknown quantity "blood-poison" as applied to the *exciting cause* of any of these diseases.

These remarks are not made with reference to the results of ear complications in the diseases under review, as a source of subsequent deafness, and respecting the neglect of which during their progress, the writers of aural works animadvert with justice. My object is rather to call attention to the fact that not so much the future *hearing power* of the patient, but the immediate issues of life or death depend upon the recognition of the mischief going on in the recesses of the auditory apparatus from the *beginning* of the illness.

On this point it is necessary to lay some stress, because it is customary for the symptoms in question to be referred to the progressive invasion of the ear owing to continuity of tissue, from the throat or nose.

But when we remember that the eruption is present in the mucous membrane of the respiratory and digestive tracts from the very commencement of the attack, the fact that the same membrane is present in the middle ear indicates that this region is likewise obnoxious to the same eruption which is elsewhere present. This is palpably the case in the conjunctiva, and if a small-pox pustule can occur here, why may it not in the tympanic cavity? the same remark applies to measles, to scarlet fever, and throughout the entire category of the exanthemata.

It is true that such mischief going on in the tympanic cavity may require some period for its development, because it is not until corresponding processes occurring in the post-nasal space, by producing swelling and closure of the orifice of the Eustachian tube, cut off this passage of escape for the increased secretions and inflammatory products taking place in the chamber to which this appendage forms a natural safety valve. Thus it happens that the patient, who, to all appearances has been progressing favourably through the early part of the illness, will, about the end of the second week or earlier, manifest very serious symptoms. He will become restless, cry out as if in pain, while his manner becomes dogged and obstinate when roused from the semi-stupor in which he is otherwise disposed to remain. At the same time there may be no corresponding rise of temperature indicative of fresh inflammatory mischief. In a very short time, however, there will commence that rolling of the head from side to side which has already been referred to pressure on the intra-labyrinthine fluid.

The faintest approach of any of those symptoms should call immediate attention to the ear. First of all the nasal passages should be cleared of mucus by means of a feather or piece of sponge secured to the end of an aluminium wire, which can be readily bent to suit the purpose, after which they may be syringed with a solution of chlorate of potash and bicarbonate of soda, to which a little Condyl's fluid should be added. After this proceeding it will be well to use Politzer's method of inflating the ear, but gently; no harm can come of this, because if air can be forced into the tube, the other contents will be expelled. Moreover, it is not necessary in very young children to use water, or any of the various methods for confining the air of the douche to the post-nasal space, the simple condensation of the air which occurs during the process being sufficient to cause it to enter the tubes.

These precautionary measures should, however, be adopted from the commencement, and if done firmly and dexterously, will prove so comforting to the patient (especially the *syringing*) that however fractious he may at first be under them, there will soon be no difficulty in getting him to submit. It may be observed in passing that this proceeding should never be omitted in syphilitic infants where the existence of snuffles renders probable the presence of mucous patches in the nasal organ, of course accompanied with suitable constitutional treatment.

From the commencement of an attack of any exanthem, the drum-head should be kept under observation, just indeed as the conjunctiva would be under similar

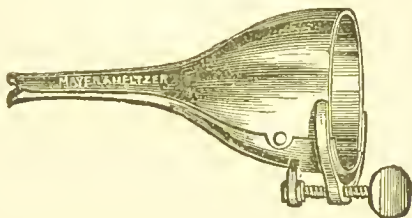
circumstances, with the view of subjecting it to suitable treatment; because the early application of a leech as already intimated, will prevent future trouble, in fact may obviate the necessity for the step we have now to consider, that of *puncturing the membrane*.

In this, as in every other surgical interference in the region of the ear, the first point is to obtain a good view of the exact spot to be operated upon, and with suitable appliances this will not be difficult. In children the external canal is much shorter than it becomes in later life when development is complete, the deficiency in the length being due to the absence of the inner bony section of the canal which is at present represented by the osseous ring into which the tympanic membrane is fixed. The external canal being thus reduced in length, the drum-head at its distal end is proportionately near. The advantage thus arising is counterbalanced by the almost horizontal plane which the membrane now occupies with reference to the passage by which it is approached; hence though nearer to hand less of it is seen. It is also to be remembered that it is the inferior segment of the canal which may be opened without risk of injury to the ossicles.

With these facts in mind, the patient should be placed in such a position that he can be held firmly, and which will admit of a *good light* being thrown into the ear. Various *specula* have been introduced for facilitating a view of the deeper-seated tissues of the ear. For operating purposes they are all defective, inasmuch as they impede the free manipulation of the instrument. I have endeavoured to remedy these defects in the in-

strument figured in the adjoining cut. It is a bi-valve *instrument* not unlike Charrière's, but with much smaller blades and made as light as possible, so that when in-

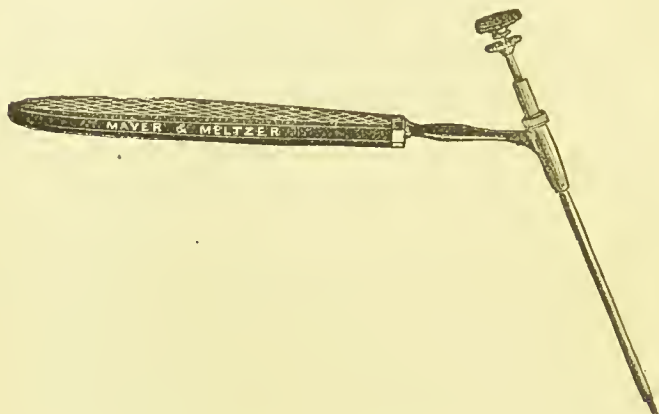
FIG. 6.



troduced, it retains itself, and occupies very little space; its use will be found to facilitate most proceedings of an operative nature in the region of the drum. To illuminate the aural fundus a good lamp should be placed near the patient's head, the flame of which is reflected from a short-focus mirror, about four inches, worn in the ordinary spectacle frame or forehead band in use in laryngoscopy, and which may be made to replace the ordinary longer-focussed laryngeal mirror. Aided by this arrangement, a glanee will show up the now bulging and opaque membrane, when the knife can be introduced and the membrane incised; this incision, as already stated, should by preference be made through the inferior segment of the membrane, and if possible in front of the manubrium. As regards the *kind of knife* the one figured below has some advantages; it is contained in a guarded sheath, the blade being propelled by pressure on a spring, so that the right moment may be seized for completing the opera-

tion. The length of the blade can also be regulated beforehand. Its entire diameter does not exceed one and a half millimetres. These are points which give

FIG. 7.



the instrument in question considerable advantages in operating on children, though I repeat the caution that the head should always be held firmly by a reliable assistant. At the moment of the incision a creaking sound will be heard as the tense membrane gives way.

The advantage of making the puncture as forward as possible is that in this position the wound in the membrane is nearest to the opening of the Eustachian tube, a circumstance which enables the after treatment to be most advantageously carried out. It is also furthest removed from the chain of ossicles, which incur no risk of damage when the anterior segment of the membrane is selected for the operation. Apart from these considerations every surgeon would choose the most project-

ing point for incision when his object, as in the present instance, is the evacuation of pus, and myringotomy performed for this purpose offers no exception to this rule.

The *after treatment* consists in very gently syringing the ear with a solution of bicarbonate of soda in warm water to remove the fluid accumulated in the tympanic cavity. In this way not only the cavity but the mastoid cells may be washed out, the fluid escaping both by the meatus and through the Eustachian tube into the mouth, or it may run out by the nose. This latter remark applies more especially to older subjects for whom the operation has to be performed. In syringing under these circumstances, in very young infants, no force must be used or the injected fluid will press upon the membranes closing the labyrinth, and produce the effect which the operation is intended to obviate. The syringing must be repeated several times daily to prevent the establishment of an otorrhœa, and for this purpose a few drops of carbolic acid may be added to the alkaline fluid.

Irrespective of the ease with which this operation can be performed under the conditions detailed, the surgeon who may adopt it will have the double satisfaction of rescuing a life from imminent peril, as well as of preventing the certain prospect of a greater or less degree of permanent future deafness, which will be sure to ensue should the patient recover without its performance.

CHAPTER III.

SOURCES OF EAR AFFECTIONS IN INFANCY, CHILDHOOD AND ADOLESCENCE. POST-NASAL GROWTHS; ETIOLOGY; PATHOLOGY; DIAGNOSIS; TREATMENT.

THE disease which next in order of frequency to those discussed in the preceding chapters, is most operative in producing deafness during the early periods of life, is without doubt the occurrence of growths in the post-nasal space, including in this region the vault of the pharynx together with its posterior and lateral walls.

Such being the case, it is somewhat remarkable, that there does not exist a single original monograph on the subject by an English Surgeon, a fact that may perhaps be accounted for by the remark of a German Physician, to the effect that in England he had observed doctors, as a rule, did not "interrogate the nose." Be this as it may, the fact remains that we are indebted to continental authors for the earliest as well as the latest treatises on the subject. Dr. Meyer of Copenhagen was the first to draw attention to the disease, and a paper on adenoid vegetations in the naso-pharyngeal cavity by him, and published in the *Proceedings of the Royal Medico-Chirurgical Society*, Oct., 1869, was the first introduction of the subject to the Profession in this country. Dr. Loewenberg of Paris has recently published an exhaustive treatise on the disease, a good

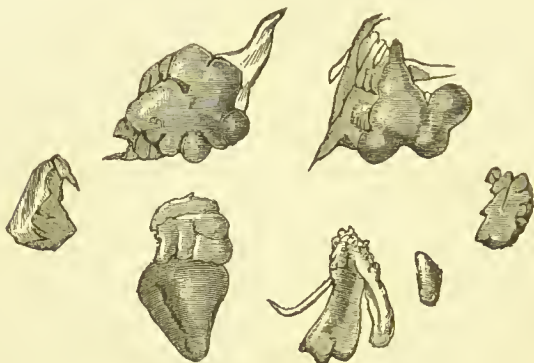
translation of which, by Dr. MacNaughton Jones, appeared in the early numbers of the *Medical Press and Circular* for 1879. In 1875 Dr. Beverley Robinson of New York published two cases, with drawings of the growths, though he adds a note stating that in his belief typical cases of pendulous vegetations in this region are rarely if ever seen in the United States. In the second edition of Dr. Cohen's "Diseases of the Throat, &c." published in 1879 the subject is dealt with more fully, conveying the impression that since attention has been called to it, the disease will be found of frequent occurrence when looked for, in America as in England. In Mr. Watson's "Diseases of the Nose" the subject is dismissed in little more than a page, as it is in Holmes' "System of Surgery," each author contenting himself with a summary of Meyer's observations. Fraenkel who treats of the Nose in Ziemssen's "Cyclopædia" only briefly alludes to the topic, probably because the treatment belongs rather to the domain of Surgery than Medicine.

The comparative neglect on the part of English Aurists and Surgeons of a subject of such great importance cannot certainly be referred to its rarity since, at the time of writing these pages, I have some eight or ten cases undergoing treatment in the wards of the Throat Hospital or in its out-patient department, and fresh cases crop up almost daily.

The disease consists in the presence of a number of growths, or vegetations occupying the post-nasal, or pharyngo-palatine space. They may be confined to the vault of the pharynx, or be scattered indiscriminately over the boundary walls of the region. They are

pedunculated or sessile, the former being nodulated or flattened masses varying in size from a horse-bean to a split pea, some are even smaller. The sessile are found

FIG. 8.



Specimens of growths after removal, natural size.

chiefly upon the posterior wall of the pharynx. The stalked variety are seldom found so low down as to be visible unless the soft palate be raised, or the rhinoscopic mirror be used to inspect them. They may be few, and scattered, or be so abundantly developed as completely to fill the post-nasal space. They vary in consistence as much as in size, some being soft and gelatinous to the touch while others are firm and unyielding. They usually bleed readily when subjected to palpation, a circumstance which has a very important bearing on the histological character of these growths.

Pathology. Up to the present time all writers have spoken of the growths occurring in the post-nasal space as hypertrophic developments of the glandular struc-

tures proper to it, and the term "adenoid growths" has for this reason been affixed to them. Thus they are usually described as multiple developments of the follicles of the pharyngeal tonsil, plus a considerable increase of the adjacent connective tissue; and in the larger masses an abundant proliferation of all the elements of mucous membrane associated with the gland structure proper.

From the commencement of my acquaintance with the disease I entertained doubts respecting the entire correctness of this view, believing them to be affiliated rather to papillomatous than to adenomatous tumours. That is, I suspected them to be *warty* rather than *glandular* in their origin. The circumstances leading to this impression were; first, the extremely wart-like appearance of many of them when removed; second, the tendency to bleed when handled, a circumstance characterising papillary growths in the bladder, and elsewhere, when mucous membrane forms the structure on which they are found; third, their probable tendency to spontaneous disappearance after adult life, like warts on the hands, &c., a fact which though requiring confirmation as regards these particular excrescences, has many circumstances to favour its acceptance.

Whatever doubt I may in deference to authority have entertained on this subject has been disposed of by the careful examination of numerous microscopical sections recently made for the purpose of ascertaining this point. They are then seen to consist of very closely packed connective tissue fibres, interspersed with cells proper to these, as well as occasional nest-like cells. The epi-

thelial element is most marked at the periphery, while the entire substance is densely crowded with the minute cells found in connective tissue in a state of active growth. There is usually a thinning of all the elements in the centre of the growth where a minute vessel passes along it, entering at the root. At this central line they show a decided tendency to part in the act of slicing, which from their softness is a difficult process.

For the above reasons I am induced to regard these vegetations as papillomata, and for others to be shortly stated, infer their origin to be congenital, or to commence shortly after birth. Growing as they do from the mucous lining of the pharyngeal vault, they cannot fail to exercise an irritating effect upon the pharyngeal tonsil, in their immediate vicinity, an influence which frequently leads to proliferating and hypertrophic changes in it, thus adding to the bulk of the obstructing mass. This latter must, however, be regarded as secondary to, and dependent upon the presence of the papillary excrescences.

If the view now advanced of the pathogenesis of the disease be correct, the term "adenoid" as applied to the vegetations is a misnomer. It would be more suitable to describe them as "papillary growths," the glandular element mentioned above being regarded as an accident of the situation of the disease; moreover, it is often absent.

Etiology. There does not appear to be any well recognised cause by which to explain the occurrence of these vegetations, beyond certain "family proclivities," on which Loewenberg insists, from the fact that they

frequently appear in several members of the same family. This is a well-attested circumstance, and was illustrated in the cases furnished by the family R—, a boy and his sister, belonging to which presented themselves for deafness, due to this disease, at my aural clinic. An elder married sister was also under treatment for polypus of the ear; attached to this was the necrosed manubrium which came away with the polypus. In this latter instance the post-nasal growths, supposing them to have been the origin of the ear mischief which resulted in polypus—an assumption favoured by the early history of this patient—have disappeared, a point to which reference will again be made. Her case, however, illustrates the probable result in serious middle ear disease extending into later life, which is the ordinary result of neglecting these growths, even though they may in the meantime have disappeared spontaneously.

At present I incline to the belief that the disease is congenital, having found it well developed in an infant aged nine months, and having operated on another just over two years of age, who had exhibited symptoms of their existence, viz., snuffles, impeded nasal respiration, and disturbed sleep, since birth. They have not so far as I can discover any relationship with syphilis, the parents in my cases being free from any such taint, except in one instance, so far as evidence on this point was obtainable.

The exact *nature* of the inherited proclivity will I think be found in enfeebled inhibitory power exercised by the vaso-motor centres over the particular tissue

tract involved, leading to hypernutritional states of this region, and which condition of tendency to local vasomotor pareses is undoubtedly transmitted by parents to their offspring.

As it is rare to meet with the disease after the age of adolescence, the question arises, what becomes of it in those numerous instances, where children so afflicted have grown up to adult life with their ailment undetected and therefore unrelieved? It is most probable that the growths disappear spontaneously, in the same way as warts on the hands and elsewhere are known to do. The gradual enlargement of the region which is their favourite habitat, and which takes place as development approaches completion in common with the rest of the facial framework, favours this presumption. Increase of space in the naso-pharyngeal region implies freer access of air, readier escape of secretions, and consequently greater dryness of the surroundings generally. The soil thus drained and ventilated appears unfitted for these vegetations to flourish upon, especially when accompanied with the increase of nerve and circulatory force, following the completion of this change, and they accordingly diminish and disappear. These papillary excrescences constitute therefore one of those few affections concerning which it may with truth be said that the patient "grows out of them." It would be most unwise, however, to wait for the advent of such spontaneous extinction, because of the detrimental consequences effected by the disease during its period of persistence, especially on the organs of hearing,—consequences which constitute for it a special demand on the attention of aurists.

Diagnosis. The symptoms exhibited by the patients who have come under my care, though similar in kind, have been very variable in degree, depending upon the extent of the growths, but more especially on the particular part of the naso-pharyngeal space from which they proceed. The most likely symptom to attract attention is *modification of the voice*. In slight cases, the natural timbre of the voice only is lost, while in those in which the tumours encroach upon the choanæ (posterior nasal meati) the voice is much altered, acquiring a nasal twang specially characterised in the pronunciation of the consonants *m* and *n*, which become respectively *b* and *d*. Thus, "common" is pronounced "cobbod," a modification with which everyone is fairly familiar as the result of a common cold.

"*Buccal Respiration*" of Loewenberg, or breathing by the mouth, is not always present, even when the disease exists to a considerable extent, as it requires for its complete production, the occlusion of the lower meatus of the nose. This is a point of some importance, because inability to breathe by the nose, being generally regarded as a collateral indication of the presence of the vegetations, their absence might be inferred, if the patient can so respire. As a matter of fact, nearly all my cases have been able to do so when tested in the ordinary way, *e.g.*, by placing the forehead mirror beneath the nostrils, and instructing the patient to pronounce the letters *m*, *n*. The mirror will be dimmed by the moisture of the expired air deposited on the glass, the space occupied by such deposit being proportionate to the freeness of the passage. It is frequently even in the normal state different for each side.

The reason of this ability to breathe through the nostrils is, that the growths abound most freely in the pharyngeal vault, and while in this position they tend to occlude the superior openings of the nasal passage, the inferior meatus is left comparatively free. It is important to note that it is along this lower passage that air chiefly passes in ordinary nasal respiration. In the upper ones the air though set in motion by the lower current, is comparatively tranquil, except in forced efforts as in sniffing or smelling, (*vide* Fraenkel, *op. cit.*) Bearing in mind this fact, it will be apparent that the ability to perform nasal respiration by no means precludes the possible presence of the growths, which, if otherwise indicated, must be searched for as subsequently directed.

Where the occlusion of the choanæ is complete buccal respiration of necessity follows, associated with all those inconveniences to the lower portion of the respiratory tract, resulting from the inspiration of air which is "drier, cooler, and more unclean," than it is when warmed, moistened, and filtered, during its transition through the nasal channels. Provision for these influences upon the air is supplied by the peculiar erectile tissue with which the mucous membrane covering the turbinated bones is furnished. The credit of discovering this tissue is claimed for Kohlrausch, who described the structure minutely in Müller's *Archives*, 1853. But the following note in Toynbee's *Diseases of the Ear*, would seem to transfer the merit to our countryman. He says, "*many years ago* I pointed out the peculiar erectile tissue of which the nasal mucous membrane is

composed, not only in man, but in most mammalia; this tissue is a most efficient natural 'respirator,'" (p. 200 *op. cit.*) Judging from Loewenberg's insistence, it would appear that buccal respiration obtains in these cases, to a much greater degree on the continent than it does in this country. Where it does occur to any extent, the expression of the patient is markedly changed from the mouth being always open, by which a very stupid appearance is imparted to the physiognomy. Obstruction of the nasal air-passages is commonly increased by the accumulation of a muco-purulent discharge in the post-nasal space, from which it escapes both by the anterior nasal meatus as well as by the pharynx. It is a source of great annoyance to the sufferer, whose excoriated nostrils testify to its irritating character. At the same time he is frequently unable to blow the nose.

Impeded nasal respiration from whatever cause arising, and it acknowledges many others besides that at present under review, exercises important modifications on the functions of the eustachian tube, so that its influence in the causation of deafness cannot be too strongly insisted upon.

Snoring is a symptom which always attends the presence of growths in the post-nasal region. It appears to be due to the depression of the soft palate, and its diminished pliability, consequent upon the presence of the tumours. Its free margin is thus pushed into the midst of the breath-way, and vibrates, like the reed of a wind instrument, with each act of expiration. I have not noticed any special *loss of taste or smell* in my cases,

though these senses are likely to be prejudiced in extreme instances of the disease.

"Snuffles." It has already been stated that the disease is probably congenital in its origin, being due to hereditary proclivities of a local nutritional character, and that the increase in size of the growths advances *pari passu* with that of the body generally. Hence it is that the annoyance they occasion is so frequently aggravated towards the period of puberty, and it is then perhaps that we are most frequently called upon to treat it. But these conditions must occasionally come to the front in infancy, and the fact is worth a passing remark by way of caution that they be not overlooked. The following case will illustrate the important bearing they may have in this relationship. I was asked by a surgeon to see his child, a little girl aged 9 months, respecting whom he had come to entertain the conviction that she was the subject of syphilis, on account of "snuffles," to which she had been subject in a marked degree from birth. Having been absolutely free from this disease himself, his mind was becoming the prey of the most disquieting suspicions. The child was the picture of health, and though the respiration was unmistakeably "snuffling," there was no other indication of syphilis. On passing the finger into the post-nasal space, a crop of excrescences was discovered, and the suspicious symptom reduced to its proper dimensions. This was the youngest patient in whom I have verified the presence of the disease, but there can be little doubt it would be oftener found if sought after.

Deafness is undoubtedly the symptom which, more constantly than any other, is associated with the condition under discussion. It is also that for which the patient is most frequently brought under medical observation. Lucae refers its occurrence to the exhaustion of air from the tympanic cavity, consequent upon the suppression of nasal respiration, the mechanism of which is imitated in Toynbee's experiment, *i.e.* when swallowing is performed with the nostrils closed. It is the reverse of the Valsalvan process, for while the latter distends the middle ear and pushes the membrane outwards, the former by exhausting this chamber draws the drum-head inwards. The persistence of the altered state of intra-tympanic tension implied in complete nasal obstruction, presents very serious interferences with the hearing power of the patient, the characteristics of which are described later on. But, as already stated, it is comparatively rare for nasal respiration to be completely suppressed, and yet the deafness is as constantly present where the nostrils are patent, as it is when they are occluded. The explanation of its occurrence is that the irritation produced by the papillary growths occasions inflammation of the glandular tissue of the region, as already explained, which, from its chronic character, induces a hypertrophic state of the minute glands scattered about the posterior pillars of the fauces, as well as of the back of the pharynx. When one of these adenoid hypertrophies occurs in the neighbourhood of the orifices of the eustachian tube, the zone of inflamed mucous membrane surrounding it, extends into the tube, and

excites in it a state of chronic catarrh, which soon spreads by continuity of tissue into the tympanic cavity, and may eventually lead to perforation of the membrane, and, as seen in the case already quoted, may induce chronic otorrhœa, polypus, and the gravest of all complications, necrosis of the walls of the tympanic cavity. Indeed it is a common occurrence in the outpatient department, to have a series of cases illustrating all the stages of the disease, from simple alterations of intra-tympanic tension, to otorrhœa and polypus; all of them associated with, and starting from, this papillary disease. Thus to the patients other troubles are added chronic otorrhœa and deafness. Frequently the affection of the ear is, as just stated, of a more passive type, *i.e.* non-suppurative inflammation of the tympanum with more or less depression and injection of the membrane.

As regards the treatment, it will suffice to state here that the adoption of the ordinary principles of treating catarrh of the tube will be useless, unless the local cause be first sought for and removed. This will be accomplished by two or three applications of solid nitrate of silver, guiding the salt fused on the end of an aluminum wire to the inflamed spot, by the assistance of the rhinoscopic mirror; or, the guarded caustic holder, described further on—which is a safer method of applying caustics behind the palate veil—may be used for the purpose. These remarks assume that the vegetations, the *fons et origo mali* have been already extirpated.

To a hasty observer, the foregoing train of symptoms

may be referred to the *enlarged tonsils*, which usually co-exist to a greater or less degree with the affection of the pharyngeal vault under review. If treatment be limited to their removal, the result will disappoint both operator and patient. It is very rare in my experience for deafness to depend upon hypertrophy of these organs, though their ablation may be demanded for other and independent reasons.

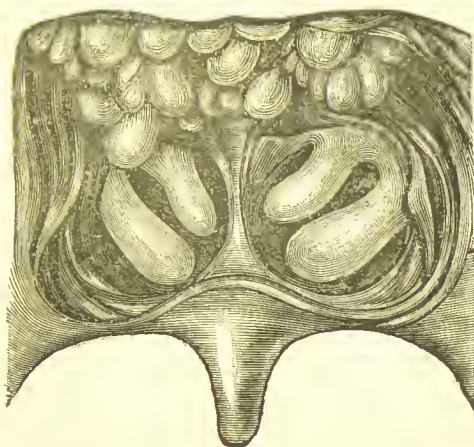
Loewenberg lays stress upon *certain deformities of the chest walls* as the result of this adenoid or papillary disease. I have carefully looked for this condition, but have never met with it in any case that has come under my care. The boy R — is stated to have been hydrocephalic in infancy, and to have been further afflicted with curvature of the spine. Neither condition had left any trace of its former existence when I saw him about the age of 14 years: notwithstanding his case was a severe one, the growths removed from his post-nasal cavity equalling in the aggregate, the size of a small pullet's egg. During the existence of the affection both the children of this family suffered from *night sweats*, a condition I have observed somewhat frequently in others subject to the same disease. Is this increased activity of the skin complementary of the impediment to respiration?

Examination of patients. When the throat of a young child, the subject of papillary and adenoid growths is inspected, the veil of the palate is seen to project somewhat forwards, imparting a greater depth to the space between it and the posterior wall of the pharynx. This feature, though a very frequent, is not a constant one.

The posterior pillars are usually hypertrophied, and tend by their increased size to narrow the fauces laterally. If, as is sure to happen, the fauces contract during inspection a mass of mucus is squeezed downwards by the effort, so as to become visible to the observer. Should the examination be allowed to rest here, the case might easily be mistaken for one of post-nasal catarrh, and the treatment be limited to it, in which event the result would prove abortive. In order to complete the examination it is well to syringe out the naso-pharyngeal space, through the anterior nares, with a warm solution of soda and water, to remove the secretion. Rhinoscopy in such young children is invariably negative in its results, and may be dispensed with for the more certain indications afforded by palpation.

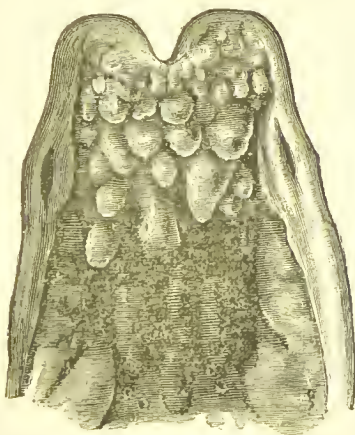
To make a digital examination with the best effect, the left arm of the surgeon should be passed round the patient's head, so as to support it against himself, while his left hand rests on the patient's chin. By this means he can, at the proper moment, restrain any effort to close the teeth on his finger, an effort which patients of all ages seem unable to resist. The index finger of the right hand is then passed upwards behind the soft palate, care being taken not to carry the uvula with it. The growths will then be encountered, frequently in all directions, but more especially congregated in the vault of the pharynx. When present in considerable amount the sensation imparted to the finger is that of an irregular soft mass, which by continental writers has been fancifully, but not inaptly, compared to touching a "bunch of worms." With a

FIG. 9.



Rhinoscopic view of vault of pharynx showing papillary growths.

FIG. 10.



Posterior wall of pharynx similarly affected. The group of non-pendulous projections, occupying the lower third of the wall, represent hypertrophies of the mucous glands proper.

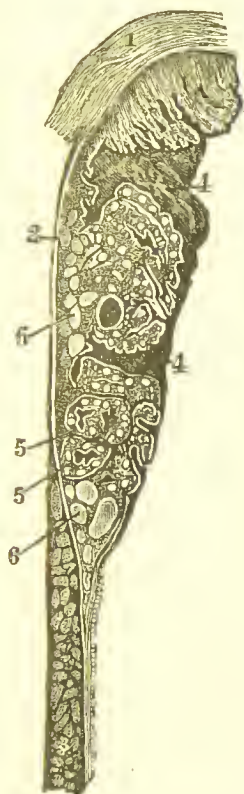
little practice the finger may be made to examine the entire space, and so to discover the exact situation of the growths. It is not therefore necessary to introduce first one index finger and then the other, as advised by some authorities for this purpose. The mass bleeds very readily, as do papillary growths from mucous membrane in other situations, so that when the finger is withdrawn it is usually smeared with blood. This proceeding if skilfully conducted is, though exceedingly disagreeable, almost free from pain. In older persons the rhinoscope may be used when the appearances will more or less resemble the condition represented in the engravings.

As regards *differential diagnosis*, the only disease with which that under review is likely to be mistaken, is the form of post-nasal catarrh associated with chronic inflammatory enlargement of the *pharyngeal tonsil*, which occupies the vault and a portion of the posterior wall of the pharyngo-nasal space. This very troublesome affection of early life was, I believe, first described by Dr. Andrew Clark in the "London Hospital Reports," 1864. Respecting the function of this gland Dr. Clark records that its healthy secretion is capable of converting starch into sugar. It is to the researches of Luschka that we are indebted for the most complete description of this little known organ, and the accompanying illustration is from his anatomical atlas.

Catarrhal affections of the pharyngeal tonsil have a special interest from an otological point of view, inasmuch as they excite similar processes in the eustachian tubes, and thus furnish an occasional cause of deafness. The gland is

usually thus irritated to undue activity by the presence of papillary excrescences in its vicinity, and then contributes a large share of the discharge which has

FIG. 11.



1. Basilar fibro-cartilage.
2. Internal pharyngeal fascia.
3. Superior constrictor muscle of pharynx.
4. Lacunæ of tonsil.
5. Section of single capsule with follicles in wall.
6. Acinose mucous glands.

been seen to attend the graver form of disease. By means of palpation and rhinoscopy it should not be difficult to make out to which of these conditions the patient's symptoms are referable. The treatment is discussed as far as it concerns our present purpose at a later period of this work. *Nasal polypus* and *fibroid growths* have each their distinctive characters, but they are diseases occurring with exceptional rarity at the early period of life with which we are now concerned, and are therefore scarcely likely to complicate the diagnosis.

Treatment. It is to be premised that constitutional measures are absolutely useless for effecting a diminution of the excrescences. Whatever depreciation the system may have undergone in consequence of the disease, cannot be remedied till the mechanical obstruction to respiration, consequent upon it, is removed, and this can only be satisfactorily accomplished by operative interference. Neither do I attach importance to the use of caustics if the growths are abundant, and their use in slight cases is more painful and prolonged, than would be their instrumental removal. Caustics, however, come in very usefully to get rid of such fragmentary remains as may be left after operative measures have cleared the space of the bulk of the tumours.

The first case in which I operated was that of the boy aged 2 years, already referred to, and in whom the growths were located chiefly on the posterior wall of the pharynx, somewhat above the velum. At this time I was only acquainted with Meyer's cutting

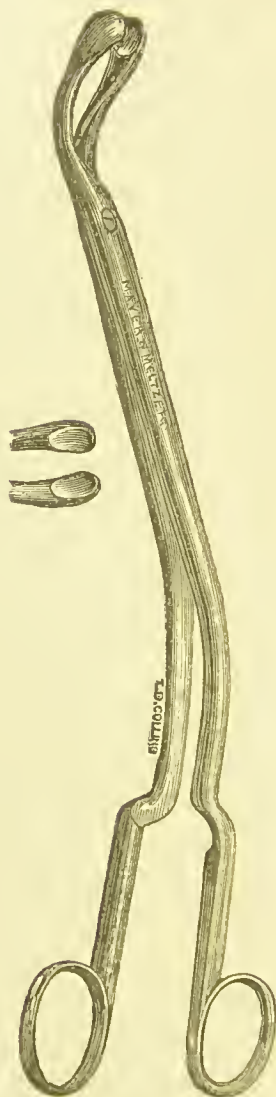
ring, and this being unsuited to the case, I used instead a pair of long dressing forceps, made with a curve adapted to the proportions of the child, with which to crush the growths. This was done with the patient anæsthetised, and with a satisfactory result. While, however, such a proceeding will answer the purpose in similar accessible cases, it is quite inadequate to deal with the severer types of the disease.

As is usually the case, each operator has his favourite instrument. Meyer of Copenhagen, who first described the disease, uses a cutting ring attached to a long stem. This is passed through the nostril into the space behind it, the growth is then pressed against its cutting edge by the index finger introduced behind the velum, and so severing the attachments of the tumours. This proceeding does not appear to have met with much favour at the hands of other surgeons.

The most generally serviceable instrument is that of Loewenberg, figured below. It consists of a long and proportionately strong pair of forceps, curved like the italic *f* and cutting at the rounded points. I have found it expedient to modify this instrument to the extent of prolonging the cutting edges of the blades on the posterior aspect, in order to adapt them to the frequently recurring necessity of dealing more easily with such excrescences as grow from the posterior wall of the pharynx.

Dr. Delstanche, of Brussels, has invented an ingenious instrument for the purpose in view, which he calls a "sliding adenatome," the method of using which he was good enough to demonstrate to me recently. It is

FIG. 12.



Loewenberg's Forceps

adapted to crush, or cut off, the growth, and appears to be admirably designed for either object, but at present I have had no opportunity of testing its comparative merits.

Various appliances have been designed for conveying caustics to a given spot behind the velum, the common object of all being to do so without touching the surrounding tissues. This is accomplished by covering the surface on which the fused caustic has been applied with a vulcanite slide, which is withdrawn by a suitable arrangement, when the holder reaches the point of application. As already intimated, I seldom have recourse to this additional expedient, it being usually sufficient to remove as many of the tumours as can be conveniently seized with the forceps; the bruising which this entails on the remaining portions, impairs their vitality, after which they wither and disappear, or at any rate occasion no further inconvenience. It is generally necessary to have two or three sittings to effect a sufficient clearance.

The question of the use of *anæsthetics* is one to be decided rather by the amenability of the patient than by the pain of the operation, which is comparatively slight. In very young and restive subjects they must be had recourse to, in order to permit the manipulations of the operator. A noteworthy fact, which I have repeatedly verified in connection with this point, is that however deeply a patient may be anæsthetised, immediately the finger, or the instrument, is introduced behind the velum, a quite immediate return to semi-consciousness is commenced, which greatly interferes

with the progress of the operation. This occurrence suggests a ready method of restoration should an emergency arise during anæsthesia induced for any purpose, viz. to irritate with the finger the region indicated. Probably the strong motor acts of inspiration thereby excited, reach the muscles reflexly through the branches of the vagus supplied to the pharynx.

Bleeding very seldom causes trouble; it may be stopped by blowing tannin into the space with an insufflator, or it may be plugged as for epistaxis.

The *after treatment* required is very slight. Irrigation of the post-nasal region should be practised two or three times daily, with weak Condyl's fluid or solution of carbolate of soda, either by means of the nasal douche, or the anterior nasal syringe. It is well not to examine digitally for four or five days after an operation, to allow soreness to go off before doing so. For the same reason, I usually let a week or ten days elapse before repeating the operation.

When the growths are sufficiently removed and the tissues generally recovered from the interference they have suffered, treatment of the deafness through the eustachian tubes may be commenced. Should there be otorrhœa, or the ear affection have advanced so as to involve the drum-head, treatment through the external meatus of the ear should go on side by side with that of the growths.

CHAPTER IV.

SOURCES OF EAR AFFECTIONS IN ADULT LIFE. PARETIC DEAFNESS, ARISING FROM PARESIS OF THE PALATO-TUBAL MUSCLES. ETIOLOGY. DIAGNOSIS. TREATMENT.

THE important part which the muscles of the Eustachian tube enact in the mechanism of normal hearing has been long recognised, though their specific functions have yet to be assigned, but their influence, when abnormally conditioned, in producing deafness and its allied symptoms has scarcely yet received the regard it demands. Dr. Weber-Liel of Berlin, is pre-eminent, if indeed he does not stand alone, in his researches into this subject, and not only otologists but the profession at large, are indebted to him for the only accurate and exhaustive survey of the complicated anatomical and physiological relations of the Eustachian tube and its muscles. Previously to becoming acquainted with Dr. Weber-Liel's work, my attention had been forcibly attracted to this subject by observing that division of the palato-tubal muscles in the operation for the cure of cleft palate was followed on several occasions by deafness, an occurrence for which the literature of the subject had not prepared me. At the same time, among the great variety of cases coming under my observation in the out-patient department of the Hospital for Diseases of the Throat, there were many patients presenting paresis of the palate muscles, who

concurrently complained of deafness, or noises in the ears, but whose auditory apparatus, except for this defect, presented no unhealthy appearances. These clinical observations of the deteriorating effect on the Hearing power of certain pathological states of the palato-tubal muscles, lead me to conclusions which I subsequently found to be in harmony with much of what Dr. Weber-Liel had already written on the subject. I had embodied these views in a paper read before the Otological section at the meeting of the British Medical Association in Cork, and it was in discussing this paper with Dr. W.-Liel, that I became cognisant of the opinion he held and had already published in his work on "Progressive Schwerhörigkeit." While, therefore, I gladly acknowledge that he had in many respects anticipated some of my observations, the fact that similar conclusions had been independently arrived at when approached anatomically on the one hand and clinically on the other—tends greatly to their confirmation.

My object in the present chapter is to invite attention to the large number of cases of deafness and allied troubles, which, while differentiating themselves by marked characteristics from this author's disease, acknowledge in common with it the same point of departure, viz. a defective state of innervation of the tubal muscles—*i.e.*, paresis of these muscles; on which account I have called it *paretic deafness*. This condition may complicate other factors of disease; but owing to the anatomical relations of the tubal muscles with the soft palate, the diagnosis is rendered unusually easy

when the characteristic lesions induced in the latter region come to be recognised.

The experience of every aurist will bear out the statement that cases of deafness are not unfrequently met with, in which the ear itself, so far as it is open to inspection, presents very slight departure—perhaps none whatever—from the normal state, and the temptation to refer such cases to the obscure domain of what is in quite recent works described as chronic inflammation of the middle ear, is very great. Many of these cases assume quite a new complexion when the examination is made to include the region of the throat, more especially as to the condition of the soft palate, for it will then be discovered that a large proportion of such cases present a more or less marked degree of loss of power of the muscles of this region. It may appear a trite remark to observe here that a careful examination of the throat and adjacent regions should accompany every attempt to diagnose a case of ear disease. Equally obvious will be the inference, after the occurrence of a number of cases of paresis of the soft palate as the only objective morbid condition associated with defect of hearing, that a factor other than catarrh may be at the root of such defect. Thus the author came to get away from the too-stereotyped notion of an inflammatory process being the invariable concomitant of so-called *throat deafness*, while the neuroses of the palato-tubal muscles assumed more important proportions in relation to aural defects. It is necessary, however, to guard against the assumption that every case of loss of power in the palate is necessarily accom-

panied with deafness, as however difficult it may be to assign a reason for such exemption, experience points clearly enough to the fact that it exists. In short, these patients present many variations in their symptoms. Nearly all are unconscious of anything being wrong with the throat, some complain only of tinnitus, while in the majority this symptom is absent, but the deafness is unmistakeably pronounced in most.

Since my attention has been drawn to this subject I have found these palate pareses, both in hospital and private patients, unexpectedly frequent. They appear as the unrecognised legacies of long past illness, the exanthematous or continued fevers being their frequent testators; or their presence may bear witness to recent shock, or to a state of existing mental or physical strain. Further, there is abundant reason to believe that chronic post-nasal catarrh, the presence of neoplasms in the post-nasal space, and indeed most chronic diseases of this region tend to impair the functional activity of the nerves distributed to it—an impairment which may remain and induce its own set of changes in the auditory apparatus after the causes exciting it have disappeared. In these observations I find myself quite in accord with the statements advanced by Dr. Weber-Liel. The cases observed by me and discussed in the paper referred to, present some striking points of divergence from the disease described by this author as “progressive deafness,” and which divergence will be apparent by the tabular comparison of symptoms given below, of the two classes of cases.

The importance of this difference is in its patholo-

gical bearing, for whereas the patients whose condition formed the basis of my report afforded objective evidence of being the subjects of *paresis of the tensor tympani muscle*, associated with a similar state of the palate muscles—those who suffer from “progressive deafness” are described by its able delineator as having an “*antagonistic contraction*” of the tensor tympani—associated with the palate paresis—a divergence of sufficient import to constitute a distinct group of aural affections. The following is the table referred to :

SYMPTOMS IN “PROGRESSIVE DEAFNESS.”	SYMPTOMS IN “PARETIC-DEAFNESS.”
1. Paresis of palate muscles connected with middle ear.	1. Paresis of tensor palati and levator palati.
2. Characteristic signs in palate.	2. Characteristic signs in palate.
3. Antagonistic contraction of tensor tympani. <i>inducing</i>	3. Paresis of tensor tympani (probably also of stapædus). <i>permitting</i>
4. Depression of membrana tympani, with indications of permanent retraction of tendon of tensor tympani, coming on slowly.	4. Membrana tympani to remain nearly normal in appearance, but deprived of its “accommodating” power.
5. Deafness slight at first, gradually increasing, with intervals of abatement.	5. Deafness well marked from first.
6. Noises, constant.	6. Noises, exceptional.
7. Giddiness, recurring at intervals, a constant symptom.	7. Giddiness, absent throughout.
8. Progress, slowly to complete deafness, but curable in early stages.	8. Progress, quickly to recovery.

Perhaps it is not exceeding the limits of fact to affirm that these two groups of cases—excluding those

considered in the preceding chapters as referable to causes operative in infancy to produce deafness, such as dentition and the exanthemata—constitute seven-tenths of the cases of ear disease which develop themselves in the middle and declining periods of life. It is impossible therefore to over-estimate the importance of forming clear ideas respecting these forms of the disease associated with paralysis of the palato-tubal muscles.

With reference to the first group of symptoms, Dr. Weber-Liel affirms the tensor tympani to be the antagonistic muscle of the tensor palati, and that when the latter is paralysed, the former becomes antagonistically contracted, and this is what he describes as happening in the condition named by him “progressive deafness.”

On the other hand the initial morbid state in the group of symptoms forming the second column, and which I have described as “paretic deafness”—is one of paresis of both the tensor of the palate and of the drum-head. The identity of nerve-supply—from the otic ganglion, lead to the inference that such would be the case, which inference the negative appearances in the membrane given under head 4, as well as the further negations under 6 and 7, sufficiently substantiate. The very early occurrence of marked deafness is also distinctive. These patients do not appear to progress so certainly and rapidly towards severe degrees of deafness, when treatment is neglected, as in the other type of the affection. I am at this time attending a gentleman who has been deaf with but trifling increase for 17 years, most so on the left side,

which corresponds to the side of the palate exhibiting the most marked degree of paralysis, and whose palate furnished the sketch, fig. 3, frontispiece. During all this time he has never been giddy, and very rarely has he had tinnitus; he can inflate the tympanum by the valsalvan method, and the drum-head is fairly normal. Yet the watch is not heard on contact, but he hears the voice if slightly raised. It appears therefore that the deafness results from simple inability to accommodate the membrana and ossicles to receive and conduct sounds. It is clear that the tympanum is sufficiently ventilated in all these cases to prevent that altered intra-tympanic tension, which always occurs when the admission of air is excluded, and from which cause, if present, there would result collapse of the membrane with congestion, noises, and perhaps giddiness. Now I refer this comparative patency of the Eustachian tube, which is the conservative element in these cases, to the action of the subsidiary muscles of the tube, which have a distinct nerve-supply from those hitherto considered, viz., the salpingo-pharyngeus innervated by the glosso-pharyngeal, and the internal pterygoid by the 3rd division of the 5th, and whose action on the tube will, if remaining unimpaired, allow air to pass through it into the tympanum.

The merit of the discovery of the latter muscle as one of those which assist in the functions of the Eustachian tube is due to Dr. Weber-Liel. In this connection it is interesting to note how nearly Toynbee approached this discovery, as may be inferred from the following quotation. "The muscles which open the

Eustachian tube in the bird are the internal pterygoid, or rather small muscles distinct from the pterygoid, but accessory to them." (*Vide* Note, p. 193, "Diseases of the Ear").

The suggestive fact about these anatomical considerations is, that the muscles which act on the drum-head and ossicles to bring about the state of tension in the conducting media best calculated to receive and propagate vibrations of sound, are associated in their nerve-supply with the muscles whose function it is to open the tube and so secure the proper entry of air within the cavity of the middle ear, without which the accommodation of the drum-membrane could not take place. Further study of this subject will probably indicate that it is to the parietic state of the tensors of the palate and drum-head alone that the symptoms are in the main to be referred, and it is the consequences of their inactivity which will chiefly concern us in this inquiry.

Passing to the clinical aspect of paresis of the palate and tubal muscles, and bearing in mind these facts of identity of nerve-supply, it becomes clear that the existence of the palatal paresis which we can see and investigate enables us to predicate with considerable exactness the presence of a similar loss of power in the intrinsic muscles of the ear also, which we could not otherwise detect. The combination of both these conditions of paresis not only interferes with the ventilation of the tympanic cavity, but is destructive of those acts of accommodation already spoken of as essential to the accurate perception of sound-waves. We have thus brought before us a distinct phase of copho-

sis, which I venture to affirm will be found to be a very common one if looked for, and the recognition of which will prove a great gain in the differential diagnosis of the various forms of deafness. It has the further advantage of being for the most part under the control of the aurist, if properly treated.

It will of course be understood that I do not refer to that form of impairment of muscular action seen in this region as the result of follicular inflammation, or of hypertrophic thickening of the fauces, in which the submucous tissues are infiltrated and stiffened so that even the act of swallowing is attended with a marked effort. These lesions are in their essence inflammatory: they interfere with the operation of opening the cartilaginous mouth of the tube by clogging the movements of the muscles destined for this purpose, just in the same way as the excursions of the vocal cords are curtailed by an inflamed state of the mucous and submucous tissues overlying the muscles which act upon them. Persons who smoke and drink largely often exhibit this sort of throat, accompanied with more or less deafness, the latter symptom being due quite as much to the inability of the muscles to open the tube when their contraction is thus mechanically impeded, as to a catarrhal state of the lining membrane of the tube, though in many cases both conditions coexist.

The following are concomitant *signs* of throat deafness associated with paresis: inspection of the drum-head affords only negative indications—if previously healthy—though some degree of flattening of the membrane due to insufficient ventilation of the tympanic

cavity, will most likely show itself. There will be no difficulty attending the injection of air through the Eustachian catheter, as the feebly innervated muscles oppose no obstacle to its forcible direct admission in this manner, but the patient cannot usually perform the Valsalvan inflation. Such a state of things is calculated to give rise to some difficulty regarding diagnosis, which however disappears on an inspection of the fauces. Even here there may not be much to arrest the attention. The palate veil simply presents a very dependent appearance, so that the uvula is not readily visible, and the distinction between the anterior and posterior pillars is almost obliterated, causing it to present a nearly uniformly flat appearance. It has, moreover, a thin, and flabby look generally. It is often said to be relaxed, and so it is; but it is more than this: you may tickle it with the handle of a mirror, and even prod it roughly, without exciting any sign of resentment in this usually irritable region. These are the phenomena attending *bilateral* defective innervation of the muscles of the palate. (*Vide* frontispiece, fig. 2.)

In *unilateral paresis* of this region the distinctive features are much more marked. One side of the palatal arch is seen to have dropped, and there is the same tendency to obliteration of the arches of the palate on the affected side as obtains in the bilateral class. The uvula usually points to the sound side—frequently it is turned toward it in a remarked degree. The record of my cases points to a greater preference of the paresis for the left rather than the right side, and it

happens with about equal frequency in both sexes. (*Vide* frontispiece, fig. 3.)

Respecting the influence of this state of things upon the hearing power of the patient, it will, I think, be clear, from the facts already insisted upon, of the intrinsic muscles of the ear being innervated from the same sources as supply the palato-tubal muscles, that the function of these (auditory muscles) will be in abeyance in like manner with the latter. It is probable that the salpingo-pharyngeus is not implicated in the paresis, as it has a quite distinct nerve-supply, and its action assisted by that of other muscles of the tube still retaining their efficiency may open it sufficiently to admit of air entering the drum cavity. This may be the reason why there is so little depression of membrane in these cases, when viewed from the external meatus. At any rate, the patient is very deaf. The cause of the deafness becomes obvious when the faucial paresis is recognized, together with its auditory relationships. The hearing power of these patients is very variable; they usually hear fairly well in the morning, that is, after the recuperative effect of a night's rest; but the improvement wears off as the day lengthens.

As regards the nature of this paralysis, it is certainly not to be referred to a central origin. On the contrary, these cases belong essentially to loss of vaso-motor nerve-power affecting one or more ganglia of the sympathetic system. This general statement will not be understood to include those cases of palato-tubal paralysis seen in syphilitic patients, associated as it often

is in them with paralysis of the corresponding vocal cord, and probably with other and wider-reaching indications of loss of nerve-power.

These *vaso-motor pareses* are very local in their manifestations, and depend entirely on the condition of the *nervi vasorum* of the nutrient arteries of the motor sensory nerves, and not at all on the condition of the sensori-motor centres. It is a question of nutrition of the muscular nerves themselves, and this depends on the blood-supply which again is regulated by the *vaso-motor* nerves. These patients are often anæmic and have undergone mental worry, besides physical wear and tear. Under such circumstances the nerve-force is readily exhausted, especially that of the sympathetic system. Some particular ganglion parts with its force more readily than the rest. It is like an exhausted galvanic cell; you must recharge it before it will act. But while thus waiting for recharge, the coats of the vessels it should control become the play of physical forces, and under the influence of the heart's impulse they stretch and are distended with blood. This interferes with the nice balance between arterial tension and tissue demand which is essential to nutrition, and hence mal-nutrition results as far as the nerve-tissue is concerned, and hence there is defective motor function. Mechanical pressure exerted upon the motor fibrillæ is an important factor in the production of this paresis and is due to the great accession of blood within the nerve-sheath when the nutrient vessels deprived of their control, experience an enormous dilatation of their calibre.

All this is restored by a proper course of therapeutics designed to recuperate the ganglionic inhibitory function.

TREATMENT.

In treating a case of paretic deafness, the point to be borne in mind is as just stated the *exhausted functional* condition of the muscles concerned in audition consequent upon ganglionic paresis. In fact it was during the prolonged and trying winter of 1877-8, that these cases presented themselves at my ear clinic at the Throat Hospital in sufficient numbers to arrest attention. Causes which under such exceptional climatic visitations prove operative on large masses of the population, rarely cease to be so to some extent, though their influence may be exerted within much narrower circles. It is probable that the ever potent factor of functional exhaustion in the female—child-bearing—is responsible, with its allied group of uterine disturbances, for much of the deafness presented in women during the period of their reproductive activities. This fact has not escaped the keen discernment of Dr. Weber-Liel, who considered the predisposing causes of deafness now alluded to as a frequent forerunner of his progressive deafness, a remark which my own observations emphatically confirm, both as regards the purely paretic affections described in this chapter, as well as in the allied group of cases described by him as progressive deafness. It is probable that the association in this instance is not one simply of general constitutional exhaustion, but that it depends upon a more direct vaso-motor correlation between the sympa-

thetic nerves of the ear and those of the utero-genital organs. The exact channel of this correlation is difficult to trace anatomically, as it is probable that the communicating fibrillæ which associate these two regions pass along the substance of the spinal cord itself. That it is a real one, however, many interesting facts might be quoted to prove.

While, however, special attention must be directed to search for indications of paresis in the muscles of the palate as a guide to constitutional treatment, the fact must not be lost sight of that such patients are peculiarly prone to catarrhal affections, which readily become grafted upon the graver constitutional condition. These, if present, must be treated on the principles laid down in the chapters devoted to treatment of deafness generally. In the meantime, hydrobromic acid, with strychnia or the tincture of nux vomica should be administered internally. These medicines possess a definite relationship to the vessel area innervated by the ganglia whose defective action produce the phenomena of paresis described in the former part of this paper. Their action is to increase the inhibitory power exercised by the ganglia over the vessels from which it has been withdrawn, and when this is restored, an involution process as regards the morbid effects of its absence at once commences, which speedily ends in the removal of the symptoms. This appears to be the *rationale* of the action of so-called "nervine tonics." The therapeutic effect of the salts of ammonia is essentially of this character, and was illustrated in the case of another patient in whom palatal paresis of the left

side existed to a very marked extent, without deafness, but with loud tidal noises in the left ear, and to whom I gave 5 gr. doses of sesquicarbonate of ammonia three times daily, with the result that all the symptoms disappeared in a fortnight.

Phosphorus, steel, and cod-liver oil, are all more or less indicated in these patients. They are general nutrients of the nervous system, supplying the necessary fuel without which it would be useless to expect additional energy to be exercised by that particular section of it which it may be desired to excite to increased effort.

It is in these cases of defective innervation, exhibited in connection with the auditory apparatus, that the most striking utility of *electricity* as applicable to the cure of deafness will be found to reside. The induced current should be preferred in these cases, and the strength should be moderate, only such as can be comfortably borne by the patient. In using it one pole should be applied to the veil of the palate, posteriorly, for which purpose the laryngeal electrode is very suitable; the other, an ordinary sponge-holder, is placed outside the neck over the superior cervical ganglion, which is reached by making deep pressure behind the angle of the lower jaw. I am in the habit of alternating this method of application by that described later on, viz., by introducing my Eustachian electrode, a vulcanite catheter forming an insulated conductor excepting at the tip, through the nostril, into the Eustachian orifice, and to this one pole of the battery is attached; the other being applied over the mastoid process close to the pinna.

In conclusion, I wish to emphasize the importance of these cases of tubal deafness associated with paresis of muscle. The recognition of the complete correlation which exists between the muscles of the two regions—middle-ear and palate, imparts to the co-existent deafness, a constitutional significance, which at once tells its own tale. Mere loss of power in the muscles of the palate does not attract the patient's attention, for it is not sufficient to impede the act of deglutition, as whatever slight obstacle it may present mechanically to this act is readily overcome by the action of the tongue in carrying the food backwards until it is brought within the grip of the constrictors. The accompanying deafness, however, at once draws attention, and often excites the alarm of the patient. The correct diagnosis of the causes operating to produce it is of paramount importance, because we are then warned of his constitutional condition, and may give a timely caution to restrain those mental or physical excesses which have already begun to undermine his nerve-force.

At the same time we are furnished by these paretic palatal phenomena with distinct indications by which our therapeutic measures are to be guided.

Just as by already popularised methods, we judge of the state of the digestive organs by the appearances of the tongue; or, of the circulatory system by the impressions of the pulse; we may gain, from an inspection of the palate, hitherto unrecognised but unmistakeable indications of the degree to which a given patient is the subject of nutritional depressions involving his vasomotor system. When these facts are more fully re-

cognised it seems not improbable that an inspection of the region of the palate for indications concerning the nervous system, will find a place alongside of these ready methods of general diagnosis, by means of which the physician is accustomed to estimate the state of his patient's health.

The reader is referred to the frontispiece for a representation of the appearances seen in palate pareses. Fig. 1. represents the healthy state, and by comparing this with figs. 2 and 3, the changes effected in either variety of the disease will be apparent.

The following observations bearing on the subject matter of the preceding chapter, may be fittingly introduced here. They refer to the appreciation of the actions of the muscles of the middle ear (including those of the tube and palate) in accomplishing the act of accommodation, without which it is impossible to hear perfectly—by the individual who is the subject of them. It would appear, that by this act the drum-head is adjusted to receive and transmit the vibrations of the air set in motion by the sounds heard, which are of infinite variety; and that its influence, speaking generally, is conservative as regards the auditory nerve, guarding it against sudden and excessive shocks; and further that this act takes place automatically, for ordinary purposes. While, however, the initial stage of adjustment may be an unconscious one, it is apparent that it cannot be sustained without the exercise of volition, and that this is accompanied by the invocation of the muscular sense, which in its turn expresses itself as a sensation of fatigue, if sufficiently prolonged. Therefore,

although we are unconscious for the most part of exerting any muscular effort for the ordinary purposes of hearing, yet when this passes into an act of intent or prolonged listening, the attitude of the individual so engaged becomes indicative of pronounced muscular strain. This fact, when exhibited in an exaggerated phase, did not escape the observation of Sir Walter Scott, who thus describes his heroine:—

“With head upraised, and look intent,
An eye and *ear* attentive bent,
And locks flung back, and lips apart,
Like monument of Grecian art,
In *listening mood* she seemed to stand,” &c., &c.

Sustained efforts of listening are attended in many persons by fatigue, even when their hearing faculties are normal. In the deaf every attempt to hear involves the volitional act of listening, and when exercised to any extent is accompanied by a sensible amount of exhaustion, a circumstance which is emphatically recorded in the Autobiography of the late Miss H. Martineau, and largely added to the annoyances of her life-long affliction. It is probable that this sense of fatigue was in her case intensified by the constant use of an ear trumpet. These instruments by concentrating the sound conveyed to the auditory apparatus, unduly excite it to an abortive activity—abortive because it is already rendered incapable of responding commensurately to the stimulus. In this way it comes about that ear-trumpets, *et hoc genus omne*, when they do any good at all, accomplish their object at a cost

of physical strain which greatly detracts from their utility.

These remarks do not apply to an apparatus for assisting defective hearing, recently introduced from America, called the Audiphon. When this instrument is used, the bones of the face and head become the medium by which sounds are conducted to the auditory nerve, without the intervention of the conducting apparatus proper. A person so hearing is assimilated as far as this act is concerned to the condition of fishes, which having no external ears detect sounds through the vibrations of the water striking against the bones of the skull. However helpful this new resource may be it does not appear calculated to supply the complete requirements of spectacles for the deaf. A desideratum which in a perfected form has yet to be discovered.

CHAPTER V.

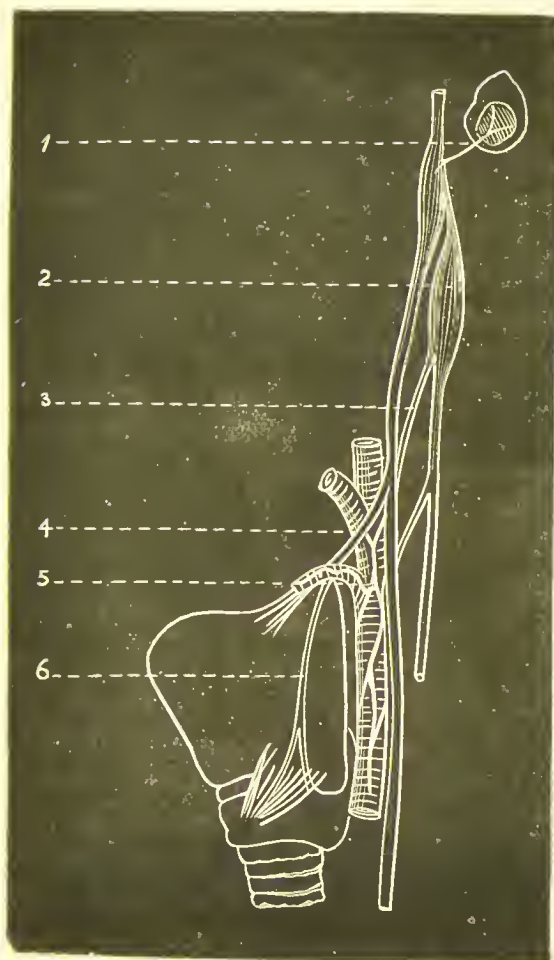
ON EAR COUGH. LARYNGEAL COMPLICATIONS DEPENDENT
ON EAR DISEASE. EAR-ACHE IN LARYNGEAL DISEASE.
“VOICE BREAKING.” EAR SNEEZING.

IN the earlier chapters of this work attention was directed to the importance of recognizing the complications which occur in the ear in certain diseases, especially during infancy, and which constitute for these affections some of their gravest conditions, involving the immediate issues of life or death to the subject of them. The subsequent defects of hearing consequent thereon, should such patients happily escape the more urgent results, have been referred to. At the same time an attempt has been made to illustrate the physiological and anatomical data by which the occurrence of these complications is rendered possible. Reverting to the plan therein adopted, there remain to be considered certain morbid phenomena exhibited by organs other than those already examined due to corresponding alliances existing between the ear and the regions exhibiting them.

One of these, the next in the series, is the symptom known as *Ear Cough*, and is due to the association of the nerves of the ear with those of the larynx.

It presents itself in the familiar phase exhibited by those subjects in whom introducing the ear-speculum is attended with spasmodic excitement of the larynx,

FIG. 13.



1. Auriculo-pneumogastic nerve passing fr. the 2nd ganglion of the vagus to the external auditory canal.

2. 1st cervical ganglion of sympathetic, receiving br. fr. ganglion of vagus, and giving off.

3. Nervi molles (vaso motor n.) to external carotid and its brs. 4.

5. Laryngeal art. Showing vaso-motor n. distributed upon it.

6. Superior laryngeal n. supplying crico-thyroid muscle.

which ceases immediately the instrument is withdrawn from the meatus. Aural literature has furnished, in an instance quoted by Arnold, an example of the effect of persistent irritation in this region attended by symptoms in the correlated part, exactly parallel with those detailed in the case of the decayed tooth, (*vide* Chap. I.) *i.e.*, trophic changes in the seat of the reflected phenomena. The case referred to is that of a girl who suffered from persistent cough, with excessive expectoration, producing extreme emaciation. It appeared that she had many months previously introduced a bean into the meatus of each ear, where they were discovered on examination. After the removal of these foreign bodies the symptoms ceased, and the patient recovered.

The chain of events, is as follows :

—The irritation of the sensitive fibres of the auriculo-pneumo-gastricus distributed in the meatus, is reflected along the motor fibres of the superior laryngeal nerve, exciting in the larynx the act of coughing by causing contraction of the crico-thyroid muscle, and in some very susceptible subjects of vomiting also. This muscular spasm would appear to be the extreme influence which these elements of nerve supply of the parts are capable of manifesting. Yet if the stimulus be sufficiently prolonged, as in Arnold's case, other conditions ensue, *viz.*, *tissue changes*, which make the evidence of participation in the process of the vaso-motor elements supplying the region quite unimpeachable. We then see functional derangement becoming structural lesion, not by varying the experiment, but simply by prolonging it.

What happens under these circumstances will be rendered clear by reference to the accompanying diagram, Fig. 13. The original irritant, *e.g.*, a bean, by its continued presence involves the vaso-motor fibres associated with the auricular nerve (1), and they conduct their impression to the secondary vaso-motor centre, the ganglion of the pneumogastric, and thence it is deflected through a sympathetic fasciculus proceeding from it to the first cervical ganglion (2). This latter, it will be remembered, furnishes the *nervi molles* to the external carotid artery and its branches, and therefore to the vessels distributed to the mucous membrane of the larynx, (5). In consequence there will commence in it that train of symptoms which we have already noted as the result of reflected vaso-dilator impressions, *viz.*, congestion of the vessels supplying the mucous membrane of the part, and shortly effusion from these vessels. In other words, a profuse mucous secretion is set up assuming a muco-purulent character if the irritation, as in the case before us, be sufficiently protracted.

If now we examine the alternative methods by which the pain thus reflexly excited on the one hand, or the hypertrophic tissue changes on the other, may be supposed to be established in the cases thus far cited, it will be seen that they are excluded, by being opposed to received physiological principles. Thus it cannot be that the conducting of a morbid impression along the sensitive fibres from one region to another will produce the symptoms, because if reflex action be excited through a sensitive nerve, this is manifested as muscular contraction in the correlated area, and

such we find to occur in the spasmodic action of the larynx under the circumstances detailed. And to this small share in the causation of symptoms the sensory-motor elements of nerve supply is limited. These being excluded from the production of the super-added trophic phenomena, we must seek elsewhere for their causation. The associated vaso-motor febrillæ existing as we have seen under conditions calculated to fulfil all the requirements for generating trophic changes, there is no alternative left us but to regard these as the potential factors in their production.*

* In an impartial review of the former edition of this work by Dr. Orne Green (*Boston Medical and Surgical Journal*, Dec. 25, 1879), it is suggested that the commotion of the larynx consequent on the cough might be the cause of the local inflammatory mischief in this organ, observed in the case under comment, and in others analogous to it. This alternative explanation had not escaped the consideration of the author, as indeed it is the one ordinarily adopted. It failed to commend itself for acceptance chiefly because such laryngeal complications are so frequently—one might say usually—absent in chronic bronchitis, whooping-cough, and other diseases in which the larynx is even more violently commoted by cough than in the cases referred to in the context.

It is against the unsatisfactory character of many of these popular explanations that the author has directed his arguments throughout. His endeavour is to indicate a principle whereby remote accessory phenomena may be scientifically explained, and to point out a mechanism by which they may be accomplished. Without the latter, the conditions of a scientific exegesis would not be fulfilled. That which has been adopted, the theory of correlated tissue tracts through the medium of afferent and efferent vaso-motor nerves, having their centre of reflex action in a given ganglion—has the merit of applicability to a great number of instances of marked tissue changes occurring at a distance from the recognised seat of irritation, where the element of commotion is absent equally with those in which it

Again, it may be urged in regard of the pain that this is reflected from the spot of sensitive nerve receiving the morbid stimulus to the peripheral distribution of another twig of the same nerve. But as already stated, it is not the function of a sensory nerve when exhibiting reflex phenomena to induce pain, but muscular contraction. There is no pain in the larynx when thus commoted, but spasm only. There being no muscles in the meatus in which contraction can be excited, no such phenomenon can be exhibited, so that we are compelled to fall back upon the interpretation of this symptom already offered—viz., vascular distension of the sensitive tissues in the region where the pain is appreciated, brought about by implication of vaso-motor nerves.

A third objection may be raised, on the plea that the original irritant excites inflammation in the nerve first affected, which spreads along its course to the spot where the pain is felt. Against such a scruple we must set these facts—the circuitous nature of the course traversed—the absence of any pain at the site of the lesion or in the intermediate steps of the path ;

exists. It is only by adducing cases where the conditions are very various, the one constant being the vaso-motor mechanism, which in some is shown to be competent to produce the result present in all, that this principle—as any other—can be established. Though some links in the chain may here and there be missing—and some lines of impulse may be wrongly traced—yet when a larger knowledge of the anatomy and physiology of the vaso-motor system is attained, allowing these errors to be rectified—the theory here broached will, it is believed, hold its ground and prove of much wider applicability than the author has yet ventured to give it.

and, lastly, the almost immediate cessation of the effect when the exciting cause is removed.

The clearing away of these obstacles will, I submit, be more difficult than the acceptance of the solution offered in the foregoing remarks.

Quitting the arena of physiology, we may gather up the threads of our narrative into a concluding practical suggestion. It occurs as a carollary to the subject of *ear cough*. If a mere mechanical irritation of the meatus will induce a temporary spasm of coughing, it would seem probable that a blast of cold air falling on this locality may have a similar effect. And still more, that if applied with sufficient intensity, though for a short period, it may operate in a similar way to a persistent mechanical irritant, and induce reflex trophic changes in the larynx. I suggest, therefore, the possibility of *spasmodic croup occasionally* owning this origin—viz., a draught of cold air falling upon the ear. In view of such a contingency, it will be worth while to provide against exposing the ears to the access of cold winds in children predisposed to this affection, a provision which can be readily arranged by allowing the hair to fall over the ears, which it would do naturally if not prevented, as well as protecting the chest and throat, to which regions attention is at present entirely confined.

Should this suggestion prove operative in warding off a disease which in inclement seasons presides as an ever-present terror in many nurseries—it will add a fresh instance to those already established, in which the study of aural relationships has thrown light on the

obscure sources of disease, and has therein assisted to remove them.

The readers of Miss Edgeworth's popular tales will recall another practical use which may be made of the relationship existing between the ear and the larynx, just indicated.

In one of these it is recorded that at a certain feast in Norway one of the guests, an ecclesiastical dignitary excited the alarm of his neighbours by the voracity with which he disposed of his food. At length, as everyone expected, the priest began to choke. In the midst of the consternation ensuing thereupon, someone present procured a pair of bellows and commenced a vigorous blast in the ear of the choking gourmand. The effect was magical: the expulsive action of the laryngeal muscles called into play by this novel method, speedily got rid of the food which the gluttonous haste of the priest had caused to "go the wrong way." As such an accident may happen in the experience of any, this incident is worth repeating for the practical nature of the suggestion it conveys.

No one who has attentively perused the foregoing observations will be surprised to find the phenomena of ear-cough occasionally following a reversed course; that is to say an irritation commencing in the larynx producing an abnormal condition in the ear. According to the writer's experience nothing is more common than to find long-standing laryngeal disease associated with deafness. Tröltzsch notices the fact, and quoting Gerhardt, states "severe pain in the ear has been observed in ulcerative destruction of the epiglottis

almost constantly, it may exist permanently, or only during the act of swallowing." It does not appear that disease of any particular region of the larynx is specially obnoxious to this association, it being common to all. The explanation of this occurrence resides in a reversal of the phenomena to which ear-cough has been ascribed. Thus in inflammation of the larynx of a sufficiently severe type to involve the superior laryngeal nerve distributed to it, waves of irritation will pass along its vaso-motor elements to the superior cervical ganglion. Thence the impression will be transferred, through the *nervi molles* to the middle meningeal artery, one of the nutrient arteries of the middle ear, as a dilating influence, with the result so often indicated, congestion, and pain from distension, in the correlated region. This may be so persistent that chronic inflammation of the tympanic cavity occurs with more or less of consequent deafness, or, it may be so transient as to give only a momentary sense of pain.

The study of the processes operating to produce ear cough, more especially those trophic changes in the larynx set up by prolonged irritation of the external auditory canal—as in Arnold's case—has suggested the explanation of a set of symptoms very usually seen in association with ordinary laryngeal catarrh, and concerning which no satisfactory account has hitherto been rendered. I refer to those modifications of the voice, due to incomplete and unequal tension of the vocal cords, which for the most part precede the more palpable hyperæmic phenomena to the presence of which we are in the habit of according the proof that inflammation of the organ exists.

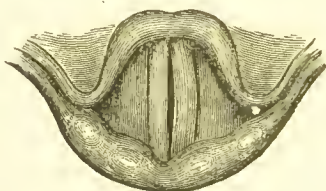
The fact referred to, that more or less *paresis of the vocal cords* is of very common occurrence in catarrhal inflammation of the larynx, and that this paresis manifests itself by gaping of the cords in phonation, is one observed by all laryngologists, and is therefore of importance to be understood. It is usual to assign defective apposition of these organs occurring during inflammation to one of the following causes: a mechanical interference with the excursive influence of the muscles, as when from the situation of the swelling the arytenoid cartilages are unable to move with their wonted freedom; or to the intrusion of folds of congested mucous membrane at either commissure of the cords; or, to an extension of the inflammatory infiltration to the substance of the muscles concerned in these movements. Obviously these are conditions which can apply only to advanced stages of laryngitis, and it is by no means necessary for the case to have advanced so far, the paralytic condition being occasionally very marked before hyperæmia sets in, or when it is present to a slight extent only. Von Ziemssen* in describing these facts remarks "much more commonly the hoarseness depends upon a derangement, *as yet unsatisfactorily explained*, in the innervation of the laryngeal muscles, or upon an alteration in the muscular substance itself."

As far as my own experience extends the condition referred to may be best observed the earlier the case is examined. At this time there will usually be seen a

* *Cyclopædia of Practical Medicine*, vol. iv., p. 203

tremulous state of the vocal cords, often more marked in one than the other, as well as an uncertainty in their apposition. This state of things may easily be overlooked, though it is rarely absent in the early stage of the subacute forms of inflammation of the larynx so common in the colder months of this climate. The minor form of disturbed innervation, trembling and uncertain action, may be the only indication of its existence which the case may manifest. Occasionally, however, it takes the more decided appearance of gaping, of which the accompanying diagram (after Ziemssen) gives a good idea.

FIG. 14.



Gaping of cords in phonation in early stage of laryngitis. (After Ziemssen.)

The physiological observations recorded in the preceding pages, will I think throw some light upon the "derangement in the innervation of the laryngeal muscles" which according to Ziemssen has not yet been "satisfactorily explained." The occurrences in question are in reality the initial processes of an inflammation, and they point quite clearly to the nerves of the part as the medium through which this condition is established.

I will take by way of illustration, the frequently occurring example of a coachman who has been ex-

posed on his box for several hours to east wind and rain, especially as regards his face and neck, and who in the evening finds his voice husky, shrill, or faltering. If this man's larynx be now examined with the mirror, there will be seen the tremulous state of the vocal cords referred to, together with defective parallelism of these organs which will be most obvious when he attempts to speak. As yet there is no very perceptible reddening of the mucous lining of the larynx. What then has occurred to explain the peculiar action of the cords, and the altered condition of the voice dependent thereon? Commencing with the exciting cause of the attack, draughts of cold air and wet impinging on the surface, we are taught by the analogous conditions in ear cough, and the similarly analogous ones in tobacco-poisoning, &c. referred to later on, how the impression is conveyed by the afferent vaso-motor nerves associated with the cerebro-spinal nerves of the surface receiving the chill to the sympathetic ganglion with which they communicate, which is in this instance the superior cervical ganglion. This vaso-motor sub-centre regulates the supply of blood to the larynx, amongst other regions, and in the case before us transmits the impression received from the cutaneous surface in the form of a wave of vessel-dilatation to the laryngeal vessels. This impulse is first appreciated in the peripheral arterioles, markedly in the vasi-nervorum, in which location the distension makes itself felt immediately, owing to the fact that the containing sheath of the nerves allows of no room for the accommodation of the increased supply of blood sent into the tubules.

The increase in the calibre of the vessels, under the circumstances portrayed, is such that they become capable of receiving considerably more blood than they did previously to the disturbance of their equilibrium.*

In order to understand the effect of this pressure on the nerve fibrillæ contained within the nerve sheath, it will be desirable to compare it with a similar state of things in another member. For this purpose the reader is referred to the remarks in Chapter viii. on the effects produced by tobacco-smoking on the arms, and to a further illustration of a similar set of phenomena occurring in the case of "occipital headache" from lesion of the stomach. The vessel dilating wave has in these cases extended to the vasi-nervorum of the brachial nerves, through the medium of the inferior cervical ganglion, inducing a feeling of weariness and listlessness in the limbs in which they hang in a seemingly useless manner by the patient's sides; this condition preceded the general congestion of the extremities in the latter case by a considerable period.

Of a like character is the effect produced by the excess of blood to the nutrient vessels of the laryngeal nerves. The state of tension within the nerve-sheaths thereby established prejudices the two-fold functions, sensory and motor, of their fibrillæ. Hence, they are less susceptible to the stimuli which usually evoke their action, responding in consequence more slowly to these; while the response when it is excited is irregular in its

* See an important article "on the action of thermal applications to the skin" translated by Dr. Lauder Brunton, *Practitioner*, April, 1878.

character, and uncertain in its result. A combination of these two factors suffices to account for the tremulous vibrations of the cords as well as their defective apposition (gaping) in the condition under review.

This then is the explanation offered for the "frequent huskiness, jarring, and shrillness of the voice for which in so many cases no satisfactory cause can be discerned by the laryngoscope" (Ziemssen), and which as we have seen are the frequent precursors of laryngeal catarrh.

Corresponding phenomena usually known as the "*Voice Breaking*" are common though not constant attendants upon the developmental processes occurring about the age of puberty. The generally recognized fact that more or less laryngitis exists at this time is one of great interest from the point of view now advocated. It means that the organs which at this period undergo such a marked accession of development, do so in virtue of a cycle of hypernutrition through which the subject passes at the time, and which nutritional wave is diverted to special organs through the medium of the vaso-motor system in the manner already indicated. That is to say vessel-dilating impressions proceed from certain ganglia which allow an increase in the supply of blood and therefore of the elements of growth, to the selected organs, amongst these to the larynx. But this normal proceeding is liable to incidental occurrences which are not really necessary to its accomplishment. One of these is the derangement of the innervation of the muscles of the larynx from the tension of the nerve fibres in the manner above described, and to which may be referred most of those eccentric performances of

phonation in a youth whose voice is "breaking." While the congested state of the organ, when it occurs indicates a still further excess of nutrition, showing that there is but a step between the natural processes of growth, and the morbid ones of inflammation.

EAR SNEEZING.

The subject of *Ear Sneezing* has recently received some prominence in consequence of a case of this kind reported by Dr. James Russell of Birmingham, in the *British Medical Journal*, for Dec. 13, 1879. On account of its interest and importance I will quote the case in extenso, which will afford the reader an opportunity of comparing the views advanced by the reporter in explanation of the attendant phenomena, with those which I have adopted, and which I communicated to the Medical Society of London, while this volume was in the press. Dr. Russell writes thus, the italics being mine to emphasise the points at issue:—

"An explanation of the prominent phenomenon in the following case, viz., the constant attacks of sneezing through two days and nights, *occasioned apparently by acute inflammation of the middle ear*, will be found in a short paper by Dr. Lockhart Clark on the phenomena of ear-cough in the number of the *British Medical Journal* for Jan. 15, 1870. Were argument needed for transferring the reasoning therein from the process of coughing to that of sneezing, the concluding sentence of that paper would afford it. 'With regard to the anatomical connection and the mechanism by which I have shown that impressions made on the vagus and

on the incident fibres of the trifacial and spinal nerves, may call into action the whole class of respiratory muscles, see my memoir.' It appears also that some *sudden change within the cavity of the tympanum* in my patient, a change followed by instant deafness acted upon the heart through the inhibitory influence of the vagus, and produced fainting. It is also worth noting that there was no vertigo present, *the labyrinth having probably escaped*. I have commented upon another occasion upon the distinction between vertigo and fainting in connection with a case of so-called gastric vertigo."

"A man, aged 56, of nervous temperament, an out-patient of the Birmingham General Hospital, was in his usual health a fortnight ago, when he was suddenly taken with 'a kind of gaping and sneezing;' the gaping seemed to come from his heart. The sneezing was incessant during the next two days and nights; 'he could not tell the quantity of times he sneezed.' At last, in the afternoon of the second day, after a dreadful sneezing fit he tumbled down, and was unconscious for two or three minutes; on recovering, he was completely deaf, so much so, that not knowing what had happened, and crossing the street soon afterwards, he narrowly escaped being knocked down by a passing vehicle. On the following afternoon he began to hear on the left side, but the sound seemed 'to come the contrary way;' if from the front it appeared to come from behind; if it started from one side of the street, it appeared to come from the opposite side. Ever since he has been in *agony from a thumping through the ears*,

like a pulse beating very quickly, with a constant whizzing and a flutter in the ears. When the thumping ceased 'it was like a toothache behind his ears.' He has not had any cough nor vertigo whatever. Dr. Malet, our house physician, examined the ears for me, and found the *left ear full of wax*; this having been removed, it appeared that both tympana were acutely inflamed at the attachment of the ossicles, the right very severely, being almost in a state of suppuration. After syringing, I found that the patient distinguished a faintly ticking watch only within three quarters of an inch of his left ear; a loudly ticking watch at eight inches. On the right side he *heard nothing*, even when the watch was *applied to the ear or to the cranium.*"

The case as given above divides itself into two stages. The first consisted of two days and a night occupied with almost incessant fits of sneezing, accompanied with yawning which seemed to come from the heart, and culminating at the end of this period, in the second stage, when the patient fell down and became unconscious, and on recovery found himself quite deaf. When the ears were subsequently examined each drum-head was found in a state of acute inflammation, while the left ear was plugged with cerumen.

Respecting the first stage, the point to examine is whether the inflammation present in the ears was the cause of the fit of sneezing? an opinion which appears to be favoured by the reporter of the case. In support of this view are the following considerations. The nasal branches of the first division of the fifth nerve are the usual channels of afferent impulses by which

sneezing is excited. In the case before us, branches from the auriculo-temporal nerve—third division of fifth, were involved in the inflammation taking place in the drumhead. Now it is conceivable, that in a person of nervous temperament, as this patient is reported to be, the irritation might be conveyed afferently along this unusual channel, so as reflexly to excite the action of the respiratory muscles to produce sneezing, in the same way as customarily happens when the nasal branch of the same nerve is irritated. This, as I have said, though a conceivable issue, is not I venture to submit the probable one, for the following reasons. In the first place, the phenomenon of ear-sneezing is admittedly the same in kind as the analogous one of ear-cough, though exceeding it in extent of excursion of the reflexly excited spasm. I am aware that ear-cough has been explained by Dr. Cornelius Fox, as due to the excitation of reflex spasm in the larynx originating in irritation of the aural branches of the trifacial, and communicated to the vagus by means of the continuity of nerve elements at the roots of these nerves, and also that this explanation acquired the confirmative support of Dr. Lockhart Clark in the paper to which Dr. Russell refers, (*vide British Medical Journal*, Jan. 15, 1870), and on which he appears to base his opinion in the present instance.

In 1875 Dr. Lauder Brunton in a note in the Feb. number of the *Practitioner* quotes Brücke, who explains in his "Physiologie" the cough arising from tickling the meatus, by the fact that the vagus nerve gives off a branch (auricular) to the ear, and others to the larynx

as well as branches to the pharynx. In the same number of the *Practitioner* the case of Dr. Cleland is quoted (from *Lancet*, Dec. 5th, 1874) in whose right ear there was "one particular spot of limited extent in the floor of the meatus, about an inch from the outside, and not extending inwards to the membrane, nor at all to the sides and roof, which, when pressed upon by an instrument, produces uncontrollable and most violent coughing." The spot here mapped out corresponds with that to which the auricular branch of the vagus is distributed. There can be no doubt that this is the real channel of communication by which a foreign body in the ear excites coughing; it is that which I had independently adopted on anatomical grounds, before I was acquainted with Brücke's prior explanation, in a paper on "some Sympathetic ear Symptoms" read before the Medical Society in Feb. 1877. In reexamining the subject for this work, I have adhered to this latter channel as the one taken by impressions reaching the larynx from the ear, for the further reason that it affords a fitting explanation through its correlated vaso-motor communications of those trophic changes in the larynx occasionally met with as the consequence of the retention of foreign bodies in the ear. It is now the almost universally accepted theory, and would scarcely require discussion but for the adhesion to the alternative channel propounded by Dr. Fox, and adopted by Dr. Russell in the case just quoted.

Examining this alternative course, it is clear that if *ear-cough* be caused by irritation of the third branch of the fifth nerve exciting the motor-laryngeal branches of

the vagus through communications existing between the roots of these nerves, which is the contention of Drs. Fox, Clarke, and Russell, and which, if there were no more direct channels might be allowed to pass, this circuit would not explain the *sneezing*, with which act as a motor nerve the vagus can have nothing to do. On the supposition therefore that the sneezing is only a more extended impression than occurs in ear cough, conducted to the vagus by the trigeminus from the ear, there is required yet another set of sympathies by which to induce this act. The impression thus conveyed to the vagus must be reflected to the spinal nerves of respiration, the phrenic, intercostals, &c. to excite in them the violent expiratory efforts necessary to produce sneezing. This circuitous course would probably be rejected if there were no alternative channel, in favour of the simpler one first suggested, in which the third branch of the fifth, instead of as ordinarily the first branch, has become the medium of excitation for the spinal nerves of respiration. But the acceptance of this explanation separates the phenomenon of ear-sneezing from that of ear-cough, as it leaves the vagus out of the question.

But another symptom manifested in the first stage of the attack points clearly to the fact that the vagus was implicated; it is the gaping which "seemed to come from the heart," and is the crucial symptom of the series indicating by this præcordial distress that the cardiac nerves of the pneumogastric were at any rate involved.

The clue to the right interpretation of the condition of this patient resides in the circumstance that the left ear was plugged with cerumen. The relationship of

this feature to the symptoms, appears to have been disregarded so far as their exposition is concerned. Its importance resides in the fact that it constituted a source of local irritation to the auricular branch of the pneumogastric, distributed to the floor of the external auditory canal, and establishing a direct communication between it and the vagus.

In the number of the Journal, Jan. 15th, 1870, in which Dr. L. Clarke discusses the physiology of ear-cough, will be found a case of this affection reported by Mr. W. Bush of Bath, due to the presence of hardened cerumen, and which was cured on its removal; such cases are not rare. As regards causation therefore, the connection between ear-cough and ear-sneezing, may be considered as identical. Assuming then the auriculo-pneumogastric nerve to be the medium through which the irritating impression was conveyed, in the case under review, I would submit the following explanation of the sneezing, &c. resulting therefrom, as exhibited in Dr. Russell's patient.

To begin with the *Gaping*: the original impression having travelled along the vagus to its pulmonary branches gives rise in the lungs to a sensation akin to that of "besoin de respire," or want of breath, to relieve which the inspiratory muscles become reflexly excited to fill the lungs. The extreme descent of the lower jaw in the act of yawning is significant, as showing how early the *reflex* sympathies excited by the vagus were felt in the fifth nerve, a circumstance which may be accounted for by the intimate communication of their roots as indicated in the elaborate dissections of

Dr. Lockhart Clarke. But it is further interesting as affording a reason for the apparently fastidious supply of the anterior belly of the digastric muscle from the fifth nerve, while the posterior belly is provided by the seventh nerve. For this anterior section of the digastric being with its fellow chiefly instrumental in extending the jaw, is by this arrangement of its nerve supply coordinated with others, which subserve the purposes of deep inspiration, an act which gaping is known to facilitate.

The compensatory act of yawning failed, however, to satisfy the pulmonary demand, and a further set of muscles is called into play reflexly through the vagus, viz., those of expiration, and the lungs being already distended with air, this is violently expelled. At the same time the arches of the palate are approximated and brought forward against the tongue, so that egress through the mouth being closed, while that through the nose is thrown open, the suddenly compressed air rushes out through the nostrils, accomplishing the act of sneezing. It is obvious that this reflex excitation of the respiratory functions of the fifth nerve, and the spinal nerves through the vagus, is totally distinct from the reverse process by which the original irritation is supposed to reside in a branch of the fifth, and passes to the vagus through their roots, and again from the latter to the expiratory spinal nerves.

The explanation offered above, obviously removes the exciting cause of the sneezing from the inflammation seen to be present in *both* membranes, and transfers it to the cerumen impacted in the external auditory canal

of one ear. How then is the existence of this inflammation to be explained? My reply is, through the vaso-motor branches implicated in this reflex irritation of the lower division of the fifth nerve, and through exactly the same medium, the otic ganglion, as the irritation of a decayed tooth will bring about a similar otitis (*vide* Chap. I.) It has been seen that various branches of this division of the fifth nerve are implicated in causing the muscular contractions necessary to produce yawning and sneezing, and it will be remembered that one of its offshoots, the internal pterygoid supplies the otic ganglion, passing through it to the tensor palati. This ganglion, thus associated with the fifth nerve, furnishes the *nervi vasorum* of the internal carotid artery at this part of its course, which here also gives a short thick trunk to the *membrana tympani*. The waves of irritation reflexly transferred from the vagus to the trigeminus exciting to spasmodic contraction the muscles of the jaw and palate, reach also the otic ganglion, and are there transferred to its inhibitory vessel nerves, becoming a source of vessel dilatation in the correlated area, the drum-head, and accounting for the congestion and inflammation present in this region.

The study of this subject will not be a fruitless one if it serves to enforce and exemplify how even a reflex impression may become a source of distant inflammation.

We now reach the second stage of the case. It is reported thus:—"At last in the afternoon of the second day, after a dreadful sneezing fit, he tumbled down and was unconscious for two or three minutes: on recovering he was completely deaf," &c. There can,

I submit, be little doubt, that the true explanation of this chain of events is as follows :— During the violent convulsive action of the muscles in this “dreadful” sneezing fit, there occurred very considerable accessions to the cerebral circulation, as well as obstruction to its return through the veins, and that a small vessel gave way in the labyrinth, probably in both labyrinths, though the subsequent history of the case, so far as it goes, points to the right semicircular canals as being more gravely affected than those of the left side. The pressure of the extravasated blood on this organ of equilibration, caused the patient to fall down. It was a true but exaggerated form of vertigo, corresponding to the chain of phenomena I have traced out in connection with the “*falling*” observed in soldiers who have received gun-shot wounds of the brachial plexus (*vide* Chap. on Giddiness). That the patient should faint and become unconscious arose from the shock propagated along the vaso-motor nerves of the vertebral artery to the inferior cervical ganglion, and thence to the heart through the inferior cardiac nerve. The effect of such a shock under any circumstances would be to enfeeble the heart’s contractions, but weakened and exhausted as this man’s heart had all along been by impressions reaching it through the cardiac branches of the vagus, and which indicated itself in the præcordial distress super-added to his other symptoms, the additional shock now conducted to it would suffice almost to paralyse its action.

Some of the conclusions arrived at when considering the subject of Vertigo in the following Chapter, are here

briefly anticipated in order to explain the phenomena attending the close of this case of ear-sneezing. I then point out the admirable provision indicated in the association of this infra-cardiac nerve with the equilibrating apparatus, any disturbance of the former being by this arrangement calculated to lay the subject of it prostrate, and so place him in the best position, mechanically, for the heart to recover itself. In fact the series of events exhibited in the second stage of this case, may be regarded as having a distinctly conservative character. The disastrous chain of reflex excitements taking place in this patient were doubtless arrested by the entire expenditure of nerve-force coincident with the access of unconsciousness. It is true that nature does not exert this conservancy without leaving traces of her beneficent interference. Such a reminder in this patient existed in the *total deafness* which followed his return to consciousness, but which to a partial extent cleared away in the course of a day or two as regards the least affected ear, the left. Its completeness was due to the shock to the auditory nerve, occurring at the time of the rupture: while the presence of extravasated blood within the labyrinths would perpetuate it until re-absorption should take place. The restoration of hearing power will be proportionate to the completeness of this process, but it is probable that some degree of permanent damage may be effected to the delicate expansion of the auditory nerves by the presence of the clots in their vicinity.

With regard to Dr. Russell's observations on the causation of the symptoms attending the second stage

of the case in which he refers them to "some sudden change within the cavity of the tympanum, a change followed by instant deafness" &c., this is hardly likely to pass, as a sufficient explanation of the occurrence. Nothing is more common than to see the acute injection of the semilunar folds of the drum-membrane, observed in the case "at the attachment of the ossicles"—a condition likely to be aggravated by syringing—yet it is foreign to all otological experience to see this *alone* produce such reflex gaping and sneezing as are here described. Still farther is it removed from such experience to find these culminate in "falling" and "unconsciousness," followed on recovery by total deafness without the labyrinth being implicated, yet in this instance it is said to have "probably escaped." Indeed, these latter symptoms will be recognised as distinctive labyrinthine phenomena; but if any further evidence were necessary to connect the internal ear with the symptoms, it is afforded by the "thumping through the ears like a pulse beating quickly," which followed recovery to consciousness; this form of pulsating tinnitus being now definitely associated with disturbance of the intra-labyrinthine circulation.

While, however, I have found occasion to differ, *in toto*, from the exegetical part of Dr. Russell's contribution to aural experience, I cannot too freely express the indebtedness to him, which all must feel who are interested in the study of ear disease, for the publication of this unique and instructive case, even to the faithful record of details at variance with his inductions from them.

CHAPTER VI.

GIDDINESS: THE CONNECTION BETWEEN STOMACHIC AND LABYRINTHINE VERTIGO. ANATOMICAL RELATIONSHIP OF INFERIOR CERVICAL GANGLION TO THE LABYRINTH: THIS GANGLION SHEWN TO BE THE MEDIUM OF CORRELATIONSHIP BETWEEN DISTANT REGIONS AND THE EAR: ANOMALOUS SYMPTOMS OCCURRING IN CONJUNCTION WITH EAR DISEASE TRACED TO THIS CORRELATIONSHIP. OBJECTIVE CONDITIONS OF AUDITORY APPARATUS ASSOCIATED WITH GIDDINESS: INTERWEAVING OF THESE WITH VASO-MOTOR DISTURBANCE PRODUCES THE PHENOMENA OF VERTIGO. ILLUSTRATIVE CASES. TREATMENT.

A GREAT deal of attention has recently been devoted to what is commonly called Menière's disease, but which, from the anatomical organ to which the symptoms are mainly referred, is also known as labyrinthine vertigo. The elaborate treatment of Dr. Hughlings Jackson, Dr. Ferrier, and Dr. Gowers, compasses the present knowledge of the subject, so far as it relates to that form of vertigo, resulting from the progressive invasion of the labyrinth from lesions of the middle ear.

But there is another class of vertiginous patients, in whom the auditory apparatus is, up to the time of the attack, perfectly healthy, and may remain so after it has passed off, whose symptoms are nevertheless due to a more or less temporary lesion of the labyrinth, to which organ in fact the general concensus of opinion

refers every such disturbance of equilibration as expresses itself in giddiness. It is to this class of cases I wish to invite attention, and as in their investigation we shall get some insight into stomachie vertigo, the area of interest of the subject will be proportionately widened.

The form of vertigo to which I allude is that in which the patient, without being aware that he is otherwise than quite well, is suddenly attacked with giddiness and falls prostrate. This may never in that patient's experience be repeated, or the attack may recur after a shorter or longer period. The cases in question differentiate themselves from those treated of by the authors referred to in the fact already stated, that the auditory apparatus is previously quite healthy, though they possess this feature in common with them that there is no loss of consciousness. *After* the attack the patient finds himself in one of the following conditions: his hearing may be normal as heretofore: or he may be quite deaf on the side to which he fell; or there may remain some impairment of hearing only, with probably confused noises in the head.

As regards concomitant symptoms, nausea and a splitting headache may remain. There is also a painful sense of fear, a horror lest the attack should be repeated, and a dread of becoming epileptic; to which apprehension the members of our profession who suffer from the attacks are specially prone.

The following example, the subject of which was a medical man personally known to me, illustrates some of these features. When about 30 years of age, and

being fully engaged in a very arduous country practice, he was one evening summoned to a patient, being already fatigued with the usual day's work; on reaching the house he became giddy, and as the door was opened fell into the hall, a proceeding which, though perfectly conscious, he was quite unable to avoid. It is needless to say he was very much frightened by the attack, but was not otherwise affected by it. In the course of the following year a second seizure occurred, exactly corresponding in character to the former, but for more than 20 years subsequently there was no repetition of the attack, although he was for a lengthened period the subject of intense headaches with tinnitus, for which he submitted to the ordinary method of depletion then in vogue. The time at which these events happened, was over 30 years ago, Menière's disease was of course unheard of, and Fleurens had not yet experimented on the semicircular canals. It was not therefore extraordinary that this patient should be haunted with the dread of becoming epileptic. So much in fact was this the case, that he frequently devised the course he should pursue should he be attacked when riding over the country roads of his district. These details are important, as they illustrate the undefined terror displayed by the subjects of labyrinthine vertigo, and though no deafness existed as their result, the symptoms are such as help to separate the disease from others cognate to it.

Adhering to the principle laid down in a former chapter, we shall seek the clue to the symptoms in the *source and vaso-motor relations of the blood-vessels supplied*

to the region manifesting them; a proceeding which will show that this particular region, the labyrinth, possesses some very remote, and possibly unlooked-for alliances.

At this point it will be necessary to repeat what I have elsewhere had occasion to insist upon, viz., that the receptive part of the auditory apparatus receives its vascular supply from a totally distinct source—the vertebral artery, to that which is furnished to the conductive portion of the ear. This in itself is a suggestive fact, as the internal carotid in its bony canal is placed so close to the internal ear that one might naturally look to it as the source whence its vessels would be derived. As a matter of fact, however, neither the external nor internal carotid is in any way concerned with the circulation of the labyrinth.* It is the *vertebral artery* and its relations we have to consider. The origin of this vessel from the subclavian deep down in the neck, and its prolonged course upwards, guarded by the bony sheath formed by the vertebral foramina, acquire an increased importance when its relations to certain nerves are considered. In the first place, this position brings it into very close proximity with the inferior cervical ganglion, (see Fig. 15, inf. cerv. G.) from which it derives a rich plexus of nerves, (vert. pl. orig.) communicating in their upward course with

* Politzer has recently made the important statement that there exist minute vascular communications between the tympanic cavity and the labyrinth, chiefly through the inner wall of the former. Whatever bearing the presence of these vessels may have on the progress of inflammatory processes from one of these regions to the other, they can exert no influence upon the functional changes in the circulation of the labyrinth treated in the text.

the several cords which form the brachial plexus (com. brs. of br. pl. with vert. pl.). It is important here to note, that this lower cervical ganglion furnishes also one of the regulatory nerves of the heart, viz., the inferior cardiac nerve, (Inf. card. n.). The experiments of Cyon and others, show that this nerve is capable of exerting very important effects on the heart's action; it "renders the individual contractions feeble and less effectual."* We wish to point out its close relationship with the nerve which regulates the supply of blood to the labyrinth, both passing through the same sympathetic ganglion. Nor can it be without design that such an arrangement exists. Glancing for a moment at one aspect only of the functions of the semi-circular canals, that viz., by which, under circumstances of altered tension of their endolymph, they are capable of causing the individual to lose his equilibrium and fall to the ground, we get some insight into the object gained, by associating the nerve which regulates this tension with that which tends to check the heart's action. The connection is such that an impression influencing the heart will affect the labyrinth. Thus a strong mental emotion arising centrally, and propagated to the heart through this channel, and which tends to enfeeble its action, will also be deflected in the ganglion to the nerve regulating the blood supply of the labyrinth, and by suddenly changing the tension in this organ, will cause the subject to fall to the ground, so removing the mechanical impediment to the circulation which the upright posture implies. In this way,

* *Vide* "Handbook for the Physiological Laboratory," page 280.

time is allowed for the excited influence of the heart to subside, while the subject of it is placed perforee in the recumbent attitude.

Referring now to the communications between this ganglion and the braehial nerves; besides those already mentioned, there are others proceeding directly from the ganglion to the braehial plexus. (Fig. 15 Br. to br. pl.) It is this arrangement doubtless, which explains an occurrence noticed in gunshot wounds of this plexus, first pointed out by Drs. Moorhouse, Mitchell, and Keen, in a treatise on gunshot wounds of nerves, published after the late Ameriean war. These observers record most succinetly, that the subject of such a wound whether received in the arm, axilla, or neck, immediately falls to the ground without losing conseiousness. This circumstance is quite unique; it has not been observed in connection with wounds of any other eorrespondingly non-vital part of the body. A certain amount of eollapse attends these cases, from which it may be legitimately inferred that the shock is conveyed not only in the direction of the labyrinth, but also through the inferior cervieal nerve to the heart.

Anyone who is conseious of the possession of what is popularly ealled the "funny bone" may, if he ehoose, verify these statements, at least to a certain extent, by giving it a blow eonsiderably in exeess of that which is sufficeient to induee the well-known tingling sensations in the fingers. It once happened to the writer to witness such an experiment in the instance of a lad, who was struck on this spot by a hard tennis ball, thrown with considerable violenee. Immediately he

became giddy and confused in his head, and would have fallen but for the support of some railings, altogether the extreme distress which he manifested appeared out of all proportion to the slightness of the cause. At the time of the occurrence, the symptoms were quite inexplicable by any known relation of the injured part. The observations of the American surgeons just quoted, as well as the anatomical continuity established through the inferior cervical ganglion between the brachial nerves and the labyrinthine circulation, (*vide diag.*) afford, I venture to submit, a ready explanation of the phenomena to anyone who candidly examines them.

It will be apparent that we are taking for granted the physiological fact, that a shock communicated to the inhibitory nerve of a vessel, temporarily withdraws its function, allowing it to become greatly distended with blood; it is this sudden distension, which produces the pressure on the endolymph, and the consequent subversion of the function of equilibration, which will be proportionate to the severity of the shock.

Having thus seen how labyrinthine vertigo of a very severe type, may be excited through these far-off alliances of the semi-circular canals, we shall be in a better position to understand the corresponding relations existing between the stomach, with its adjacent viscera, and the labyrinth. Before tracing these, it will be of service to refer to Trousseau's remarks on this subject, he being probably the first writer to call marked attention to *stomach vertigo* in his chapter entitled "*Vertigo e læso stomacho*," where he discusses

it with his usual candour. No one can carefully study the instances he adduces of this disease, without sharing the conviction that the gastric lesion was only a subsidiary factor in the production of the symptoms he refers to it. That Trousseau had himself some suspicions of this, is evidenced by his own statement. Thus, after describing the case of a lady in whom distressing giddiness, brought on by the bustle of the streets, the passing of a carriage in rapid motion—causes exactly calculated to interfere with the organ of equilibration when unduly susceptible—and who became worse by depletion and abstinence from generous diet, but was cured by tonics and restoratives, remarks, I have frequently asked myself whether “the treatment which in these cases I directed against the affection of the stomach, was not, unknown to me, addressed to the nervous system; and whether I had not diagnosed a gastric affection, rather from the effect of treatment, than from the symptoms of disease; whether I had not been led into an error in diagnosis, by obtaining success from treatment usually employed with benefit in dyspepsia.”*

In this candid commentary, my own experience of so-called stomach vertigo would lead me entirely to concur. A fair example is afforded in the following case. A gentleman, a member of the Society of Friends, consulted me some five years ago for symptoms closely corresponding with those enumerated in the foregoing quotation. He was about 73 years of age, and though never robust, was in good health, except that any

* *Lectures on Clinical Medicine*, New Syd. Society, vol. 3, p. 544.

exertion brought on giddiness, and walking in the streets was attended with a feeling that he would fall forwards. His appetite was good although the tongue was loaded, and it was observed he had no teeth, not even artificial ones, but it was ascertained that he ate meat with a relish. In view of the edentulous state of his jaws, and with Trousseau's teaching in recent recollection, he was prohibited taking any solid food. Small doses of bromide of potass were given at 6 hours intervals. Under this treatment he made a rapid recovery. After an interval of nearly a year, he returned to a mixed diet, and in a short time his old symptoms returned, but to a less extent than formerly. The same treatment was again had recourse to with a like result, and in the period that has since elapsed, the rôle of circumstances just detailed has been enacted on several occasions. In fact, the sensitiveness of this patient's stomach to solid food, appears to be proportionate to the motility of his equilibrating nervous centre. It is a suggestive feature of this case, as also of others that have occurred to me, that the progress towards recovery was invariably expedited by the bromide.

Obviously, the point at issue is, how to associate stomach vertigo with the labyrinth. A very direct channel of communication is established between the pneumogastric nerve and the lower cervical ganglion by means of a fasciculus given off by the former, about the point where the recurrent laryngeal leaves the trunk of the nerve. (Fig. 15, Br. fr. vag. to G.) That the course of this branch is from the stomach to the ganglion will

be apparent, when it is remembered that vaso-motor fibres associated with cerebro-spinal nerves pursue an opposite course to the latter. When it is further remembered that nerves entering a ganglion break up and communicate with its corpuscles, by which means they contract new relationships with other nerves entering the ganglion, it will not be difficult to understand how the stomach is brought into relationship with the labyrinth. There can we think be no doubt that this correlation is effected in the inferior cervical ganglion through the medium of the communication just noted, amongst others, from the pneumogastric to the ganglion, impressions passing along which became in it transferred to the vaso-motor nerves furnished to the vertebral artery from the ganglion.

Having established this relationship anatomically, it seems impossible not to observe the analogy existing between the shock propagated from a contused brachial nerve to the vertebral artery, with *its* concomitant vertigo, and the lesser shock caused to the nerves of the stomach by the lumps of unchewed meat swallowed by the toothless patient, and propagated thence to the same vessel, and attended with the same condition, viz., giddiness; *mutatis mutandis*, the cause, the method, and the result, are one and the same thing—the experiment is the same, the conditions only are varied. Hence it would seem, that nature had in the labyrinth erected a signal-box in which a note of warning might be sounded by the much-abused though tolerant viscus, the stomach, whenever the ill-treatment it is subjected to threatens to compromise more vital parts of the

organism. It would seem to teach us what the acquired wisdom of advancing years so often fails to do, that the senile stomach is not the fit receptacle of unmasticated meat; that it resents the slight shown it in this, and of course in many other ways, first of all by the warning attacks of giddiness, which, if not heeded, will shortly culminate in a fall. It was by such a catastrophe that the Duke of Wellington lost his life—the unscathed hero of a hundred fights, failed to prove himself master of the situation, when the forces arrayed against him were a vigorous appetite, and an acutely sympathetic labyrinthine circulation.

These observations naturally lead us to infer that the doubts, which instigated Trousseau to ask himself the question whether “the treatment which in these cases he directed against the affection of the stomach, was not, unknown to him, addressed to the nervous system,” were well-founded. The fact is, it was directed to both. By resting and restoring the digestive apparatus, he appeased those waves of excited vaso-motor sympathy, existing between this viscus and the important tracts supplied by the vertebral artery.

The establishment of a communication between the inferior cervical ganglion, and the viscera through the pneumogastric nerve, suggests an explanation of some other phenomena which frequently accompany indigestion, but which occur in distant organs. The interest attaching to these symptoms will justify a brief glance in passing. One of these is *shoulder-tip pain* and pain in some other regions of the shoulder, which is popularly associated with indigestion or liver derange-

ment. Explained by the facts we are considering, this pain would mean that a morbid impression has been reflected from any portion of the primæ-viæ to which the pneumogastric is distributed, to the lower cervical ganglion, through the channel above indicated. Thence it is passed to the plexus proceeding from the ganglion, for distribution on the subclavian artery and its branches, which plexus constitutes the vaso-motor nerves of this section of the circulation, including the vasi nervorum of the brachial nerves. (*vide* Fig. 15, Ax. pl.) One of these nerves, the supra-scapula, is unique in its course, inasmuch as it passes beneath the ligament of the notch of the spinous process in its course to the muscles of the dorsum of this bone (supra and infra-spinati), in which confined position a very little swelling will be appreciated as pain at the seat of constriction. This amount of swelling will be afforded, as we have had frequent occasion to see, by the distension of the vasi nervorum when subjected to dilator impulses; an effect which happens as the result of the impression conveyed from the stomach. Of a similar character and origin doubtless, is the *pain in other brachial nerves* which frequently is associated with indigestion; another phase of which is the aching of the arms to be considered more fully; also occurring in heart-lesion, whether functional or organic, the association in this case being derived through the cardiac nerve. *Hiccough* may own a corresponding origin through irritation of the phrenic nerve, by dilatation of the comæ nervi phrenici, inducing spasm of the diaphragm. Such a relationship receives corroboration from the case of an

aged patient who suffered from vertigo and illusions, with constant hiccough, which would last for days together. In this instance also, bromide of potassium afforded great relief. That motor excitement as well as sensory derangement, should result from the condition under review, is instanced by a patient of, I believe, Dr. Gowers, in whom automatic movements of the arm were associated with labyrinthine vertigo from disease of the middle ear.

Occipital headache is another of those symptoms which depend for their causation upon the anatomical alliances established through the medium of the inferior cervical ganglion. The following abstract of a case of this kind, published in the *Practitioner*, April, 1878, brings out several of the points already insisted upon. The repetition involved in the details, will, the writer thinks, be justified by their importance.

A professional man, aged forty-five, while seated in his office, became quite suddenly the subject of the following condition. He first experienced a sense of powerlessness in his arms, which hung down in a useless way at his sides. They were not paralysed, as he could move them quite freely on making an effort to do so. Severe pain in the back of the head followed very quickly, inducing him to rub the occiput violently with his hands in search of relief. Then running at the eyes and nose set in, and his hands became blue and cold. There was great præcordial distress, accompanied with flatulence and eructation, culminating in about an hour from the commencement of the attack in vomiting. This, however, did not relieve his other symptoms, though he threw up from his stomach his breakfast

and about two teaspoonfuls of cod-liver oil, which he had latterly been taking in the morning on account of the weak state of his health. In about two hours he was removed to his home and put to bed, all the symptoms except the vomiting continued, and to them were shortly added pains in the lower part of the back, the thighs, and calves of the legs, the most distressing symptom being the occipital headache.

It should be noted that throughout the attack there was no *vertigo*.

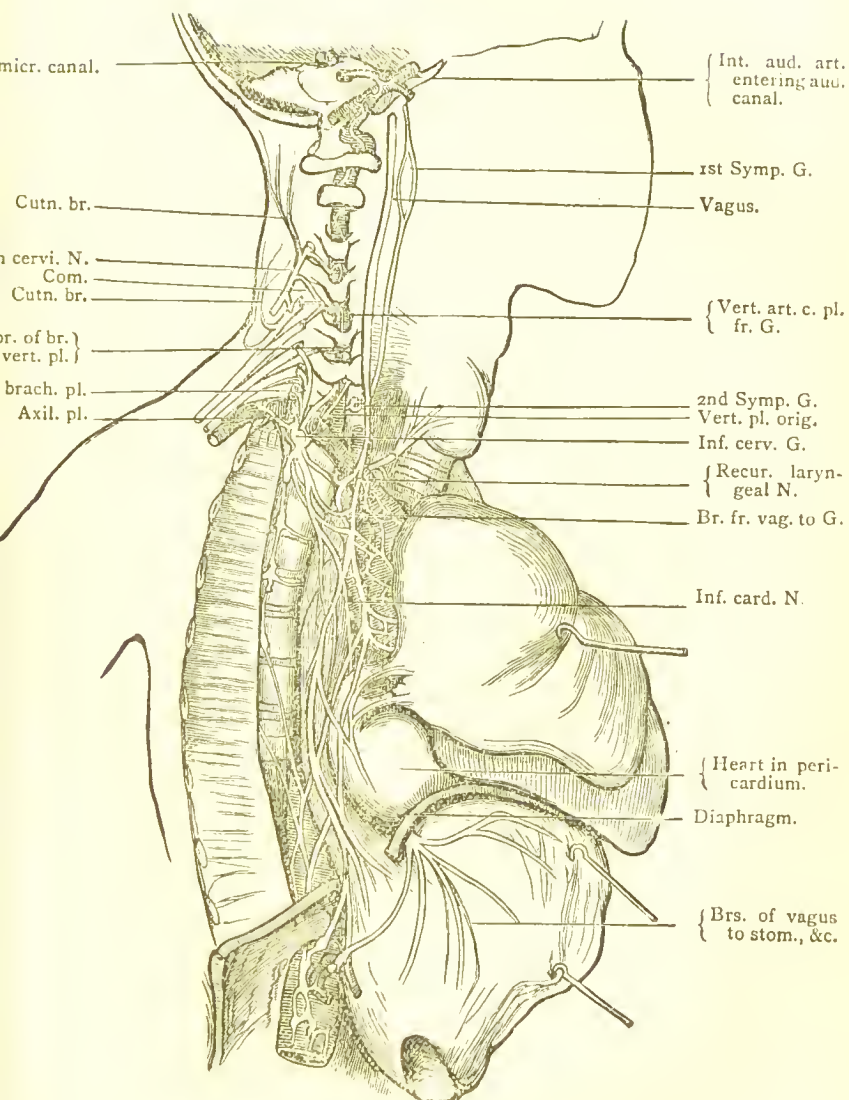
With the single exception of this last-named condition—*vertigo*—the symptoms just described bore a remarkable resemblance to those of mild poisoning by tobacco. (This patient never smoked, and was in all respects most abstemious). These are increased flow of secretion from the eyes, nose, and mouth, with a feeling of tightness in the head as though a band were stretched round it, disturbance of vision, with tinnitus and *vertigo*. Palpitation and præcordial distress follow, and notably *aching and feebleness of the arms*. Then come nausea, eructation, vomiting, clammy sweats, voidance of the contents of the bowels, in fact, a state of general collapse. If at any stage of the foregoing programme the subject of it should hold some iced water in his mouth, or better still, chew and swallow small pieces of camphor, the symptoms will gradually pass off—camphor being the physiological antagonist of tobacco, to which fact we shall have further occasion to refer.

In order to comprehend the train of symptoms just detailed, the reader is referred to the diagram delineat-

ing the relationships of the inferior cervical ganglion (Fig. 15). The prominence given to these anatomical details, will serve to indicate the important position in the animal economy which this vaso-motor sub-centre occupies. Its share in the causation of vertigo originating in the stomach has already been pointed out; when treating of "noises in the head" it will become apparent that certain of these are due to its influence; while it will now be seen that this organ is mainly concerned in the production of *occipital headache*. For this purpose, it is necessary again to call attention to the connecting links established between the vagus nerve and the ganglion, of which there are several, but for the sake of simplifying the details, one only has been notified in the figure, viz., (Br. fr. vag. to G). These cords of communication constitute the medium by which a complete correlation is established between the stomach, and the extensive areas supplied by the vertebral and brachial arteries. With the assistance afforded by these facts, we arrive at the following explanation of the symptoms manifested by the patient whose case is now under view.

First, as the exciting cause of this condition—an overdose of cod-liver oil introduced into the exhausted stomach of an already de-vitalised subject. This preliminary state is a most important factor in the production of vaso-motor phenomena, because it prepares the patient to become their subject by inducing the necessary degree of susceptibility to impressions, which may be regarded as an extreme mobility of the vaso-motor centres. This cannot be better illustrated than by again referring to tobacco-poisoning. An individual

FIG. 15.



who, in robust health, will smoke a great amount of tobacco without manifesting any appreciable effect from so doing, will, when enfeebled by any cause, experiences a more or less degree of the symptoms referable to it from smoking a single pipe.

The irritation produced under these circumstances of general depression by the presence of an indigestible dose of the oil was conveyed, in the first instance, from the stomach to the inferior cervical ganglion through the channel indicated in the diagram (br. of vagus to gang.). This impression is then transferred as a wave of vessel dilatation along the arterial trunks whose innervation is mediated by the ganglion. Tracing the effect of the concomitant afflux of blood in the *upper extremities*, our attention is arrested, first of all, by the sensation in them of lassitude and weariness in which they hang seemingly helpless by the side. The explanation of this phenomenon resides in the fact of the nutrient vessels of the brachial nerves—*vasi-nervorum*—being amongst the first to appreciate the state of passive congestion brought about in the blood-supply of the limb; moreover, as these vessels ramify within the dense limiting sheath of the spinal nerves, their expansion must exert considerable pressure upon the sensitive fibres contained therein, a state of things quite calculated to produce the sensations in the arms experienced by the patient.

The symptom now under consideration has been much overlooked in determining the ætiology of this class of disease. One may produce it at any time by smoking too freely, a statement which has been con-

firmed by the experience of observant medical men given to tobacco. Its occurrence has the crucial significance of associating the concurrent symptoms with the lower cervical ganglion. With its assistance, therefore, many obscure attacks, which would otherwise be referred to central brain mischief, may be imputed to functional derangement of a much less vital sub-centre, while the gravity of their meaning is proportionately lessened.

The congested appearance of the hands which shortly set in is directly referable to the same condition of the circulation. "The arteries in the area, being dilated, offer less resistance than before to the passage of blood, consequently more blood than usual passes through them, filling up the capillaries, and distending the veins." (*A Text Book of Physiology*, by M. Foster, M.D., 2nd edit., p. 170.) This condition, as taking place in a region open to observation, is suggestive of the state of things which will ensue under similar circumstances of vessel dilatation, in areas not thus capable of inspection.

The next symptom in the order of the occurrence was pain at the back of the head—*occipital headache*—accompanied with a feeling of weight and distress which obliged the patient to rub the occiput vigorously with his hands. This was really the most important symptom throughout the case. It was due to the extension from the ganglion of the vessel dilating impression (originating in the stomach) to the vertebral artery, which forthwith became the carrier of an excess of blood to the medulla oblongata and other centres at

the base of the brain to which this vessel and its branches are distributed. The absence of giddiness throughout the case is remarkable, for, as already intimated, the labyrinth, through the medium of the internal auditory artery, is the first organ usually to appreciate the existence of this passive arterial congestion, the pressure on the endolymph which it occasions being the direct cause of vertigo in lesions of the stomach. That this organ did participate, to some extent, in the dilated state of the vertebral circulation was shown during the early stage of the patient's convalescence. During this time his hearing became changed; he was not deaf, but every sound was heard as though muffled. It is possible also that the intensity of pain in the head absorbed all the patient's attention, so that the minor annoyance of giddiness, if present, was unnoticed by him. Throughout the illness, however, he experienced that extreme nervous depression, anxiety, and sense of impending evil which characterise labyrinthine disturbances generally.

That these various and distant tissue tracts are really correlated through the medium of the ganglion in question, receives confirmative evidence from the effects of certain drugs. Thus tobacco, as already stated, will produce giddiness, tinnitus, nausea, præcordial distress, and *aching in the arms*, amongst other conditions indicating its progressive influence over the centres of the sympathetic system. Quinine again in large doses produces giddiness, tinnitus, and occasionally in extreme chinchonism such trophic changes in the upper extremity that the cuticle will be shed like a glove. Both

these drugs, therefore, may be viewed as having a paralyzing influence over the inhibition of the lower cervical ganglion. The bromides, and notably hydro-bromic acid have an opposite effect, because they annihilate the aural symptoms of quinine; cure labyrinthine tinnitus; coupled with suitable diet they remove stomachic vertigo; and have proved highly serviceable in a case of associated hiccough. They have, moreover, a now well established therapeutic relation to epilepsy. But the fact that the treatment of epilepsy, however conducted, is greatly influenced by the diet, that the absolute withdrawal of solid food immensely expedites recovery, a circumstance which I have repeatedly proved, this fact, pointing to a direct influence between the innervation of the stomach and the condition of tone of the vertebral artery, is strongly confirmative of the reality of the correlation advocated here.

From the foregoing remarks it will be seen, that we have in the inferior cervical ganglion an organ for connecting the upper extremities, the heart, the stomach, and upper portions of the digestive apparatus, with the labyrinth. These relationships in all probability by no means exhaust its range of influence, but they suffice the objects of this discussion. The ganglion in question brings these widely separated regions into very intimate sympathy, by virtue of its regulatory power over the blood supply of the labyrinth, and of its afferent and efferent branches to the organs referred to. Returning to the case of the toothless patient, who suffered from *vertigo* whenever he partook of solid food, we take the following to be the course of events, in this, as

probably in all cases of giddiness which originate in the stomach: the ingestion of the irritant gives rise to an impression which is conveyed along the channel of communication between the pneumogastric nerve and the inferior cervical ganglion, whence it is reflected to the vertebral artery in the shape of a wave of vessel dilatation. This is equivalent to an increased flow of blood to the labyrinth, with corresponding pressure on the endolymph. This pressure, physiologically interpreted, means giddiness, so far as it relates to the semi-circular canals, and when, as usually happens, the circulation of the cochlea also becomes hyperæmic, there is concomitant tinnitus of a more or less pulsating character. If the vascular dilatation admits of effusion of serum, deafness is superadded, and if the exudation partake of the more solid particles of the blood so that a clot is formed, the deafness may be permanent. In the milder occurrences the impression will be transitory, passing away with the removal of the exciting cause.

It is to be noted that the labyrinth is placed at the extreme periphery of the tract supplied by the vertebral artery, it will, therefore, be the first to appreciate the consequences of the wave of suspended inhibition communicated to it from the ganglion. The phenomena it occasions under these circumstances are of such a marked character that they cannot fail of attracting the patient's notice; whether the oppression originate in the heart, the upper extremities, or the digestive organs, the first note of warning is thus usually struck in the labyrinth; we are therefore justified in regarding

this organ as presenting a sentinel-like office to warn the subject of changes of blood-supply about to happen throughout the whole of the important regions supplied by the vertebral artery, such for instance as the medulla oblongata, and the contiguous nerve centres at the base of the brain. Hence epilepsy or apoplexy may be about to supervene; the *petit mal* of the former disease being the signal note of the labyrinth betokening the condition of its circulation; and suggesting the search for sources of distant nerve irritation.

In the disturbance of some one or more of the multitudinous sympathies thus imperfectly sketched, will be found an explanation of the occurrence of those *simple attacks* of labyrinthine vertigo which come on *without any previously existing ear disease*, some details of which were noticed at the commencement of this chapter.

Another phenomenon associated with ear giddiness, is the congested state of the *superficial circulation of the hands and arms*, so that these regions present quite a livid aspect. It is the counterpart of the *mottling of skin*, observed after severe injuries of the nerves of the brachial plexus, and is the first step in the series of trophic changes taking place in the upper extremities of the subjects of these injuries, and which eventuate in atrophy of the limb. Occurring in connection with vertigo, this feature has a peculiar interest from my point of view, because it associates itself with the inferior cervical ganglion, from which the vessels of the arm receive their vaso-motor nerves. It points to vessel-dilating impressions originating in the labyrinth, reaching the ganglion, through the medium of which

it is propagated to the brachial vessels, producing dilatation and engorgement of the peripheral capillaries of the limb, the direct cause of the mottling.

The following case, at present under my care, affords a good illustration of this symptom, as well as of others usually found in the graver instances of ear giddiness. The patient is a lady 70 years of age, who had suffered for 6 years from noises and peculiar sensations in her head and ears, which commenced after getting wet. The tinnitus is sometimes tidal, sometimes pulsating, or both forms occur together. She suffers much from giddiness, especially in the morning, when she has a tendency to fall over on her right side. She further adds, the noises appear to draw her over to the right side, and in walking there is a strong bearing to the right. When sitting quietly in her room, an undefined object appears to pass before her. She has also a feeling of distress, sometimes amounting to pain, in the region of the heart. Altogether she presents an extremely pitiable object, sobbing frequently without cause, and scarcely able to move or sit upright. The surface of the hands and forearms, especially on the left side, is much mottled and of a dusky purple colour. This disappears on pressure, but returns immediately the pressure is withdrawn. The pulse is fair in strength, there is no arcus and no indication of atheroma, but there is marked bilateral paralysis of the palate muscles.

She hears fairly well with the right ear, but on the left side the watch is only distinguished at half an inch. Both membranes are depressed, but the left, which

presents a large cicatricial spot of thinning, rests on the inner wall of the tympanic cavity. The manubrium is drawn upwards and backwards as well as inwards. These appearances indicate the destruction in some bygone inflammation of the horizontal axis of the malleus, allowing it to yield more and more to the strain of the tensor muscle, so that it comes at length to exert a profound pressure upon the stapes, and through it upon the labyrinth. Then commence these disturbances of equilibrium manifested by this patient, disturbances which, regarded as an entity, are often called Meniere's disease.

But I have already shewn that the complete picture of this disease cannot be drawn without the aid of the inferior cervical ganglion, and here we have a patient exhibiting in the added symptom of mottling of the hands, &c., a proof of the implication of another set of branches connected with this ganglion. It is produced thus:—the pressure exerted upon the labyrinth is appreciated by the vessel nerves of this region, *i.e.*, the vasi nervorum of the vertebral artery. These impressions pass downwards to the ganglion from which the nerves originate. Here they are reflected to others of the same system, notoriously in this instance, to the inhibitory branches of the brachial vessels, as waves of dilatation, and give rise to the congested state of the superficial circulation in the hands and arms. It is a reversal of the course taken in those implications of this ganglion from contusion of the brachial nerves, (which, it will be remembered, contain febrillæ emanating from it), and being reflected to the vertebral artery

as waves of dilatation in the labyrinth, cause the subject to fall down, from the sudden alteration of tension in the equilibrating apparatus.

One other symptom associated with ear giddiness has to be examined. It is *præcordial distress*. I have already pointed out one channel by which this may be brought about, viz., through the cardiac branches of the vagus, when its auricular branch is irritated by cerum, &c. It was manifest in the patient whose yawning "seemed to come from his heart," (see case of ear sneezing). But this phase is very unusual, and the act of gaping was its immediate reflex consequence. The *præcordial distress* to which I now refer, has probably nothing to do with the vagus. It is the direct consequence of the intra-labyrinthine pressure from without, the impressions from which are reflected in the ganglion along the inferior cardiac nerves to the heart, exactly as we saw them in the preceding instance, when they were traced to the circulation of the arm. In the present case, these impressions give rise to the distressing sensations referred to the region of the heart, so frequently found in company with giddiness. Dr. David Lees in a recent communication to me says, "I was told by an old man the other day, that during his attacks of giddiness he has palpitation of the heart." The foregoing explanation will account for the cardiac disturbances so frequently seen in vertiginous patients, rather than the flatulence, biliousness, &c., to which they are usually referred.

Perhaps the following less complicated case, which I will briefly narrate, is better calculated to place the

two-fold nature of ear-giddiness in its proper light. A gentleman, æt. 28 years, was sent to me from Wolverhampton, having been the subject of giddiness for several years. He stated he had been getting deaf in his left ear for about seven months. During the past three years he has fallen down quite suddenly on four separate occasions. Respecting these falls, he states, there was no loss of consciousness, and that he always fell to his left side; afterwards, his head inclines to fall backwards. His pharynx and left Eustachian Tube were catarrhal, to which cause the deafness was due. The left membrana tympani was flat, scarcely depressed, otherwise normal. The attacks of giddiness are of frequent occurrence, and begin with a sensation of fluttering at the stomach.

In this patient repeated attacks of tubal catarrh have produced a slight degree of indrawing of the membrane, indicated by the loss of its natural curvature. This means a slight pressure upon the intra-labyrinthine fluid, not enough of itself to excite giddiness, but constituting an ever-present step in that direction, which any additional cause of pressure will exalt into a real attack of vertigo. This latter requisite is supplied whenever impressions arising in the stomach, are propagated to the labyrinth, via the channels already indicated. It is a case therefore of stomach vertigo, grafted upon a labyrinth already prepared by local mischief, to appreciate very slight impressions upon its circulation. In fact, one may hazard the opinion *that stomach vertigo is of rare occurrence where such previous local preparation in the auditory apparatus does*

not exist. For if the outrages inflicted upon the stomach always expressed themselves in giddiness, this would surely be a much more frequent symptom than it actually is.

As a general rule therefore, two factors are requisite to produce the symptom of giddiness, and its attendant phenomena. 1. Direct local pressure upon the labyrinth, the causes of which are seated in the middle ear. 2. Supplementary waves of vessel dilatation, emanating from the stomach, though by no means restricted to this organ, and traversing upwards to the cervical ganglion, and thence to the vertebral artery. The first is constantly operative, though subject to variations in degree, due to spasmodic contractions of the tensor muscle. The second is intermittent, is more under control, and indeed may be so managed as to be avoided altogether. The combination of these two factors sufficiently accounts for the uncertain and irregular appearance of the giddiness, which is one of the hitherto unexplained characteristics of the disease.

It follows from the foregoing remarks, that the *Treatment* of giddiness to be effective must be directed to the removal of its two-fold source.

In order to get rid of the direct mechanical pressure upon the labyrinth, it is of first importance to discover the cause of the tubal inefficiency, upon which the change in the intratympanic tension depends. The regions of the fauces and post-nasal space must be searched for indications of tubal catarrh, and if present they must be treated on well recognised principles. An equally common source of defective ventilation of the

tympanum, and one much more frequently overlooked, is paresis of the palato-tubal muscles. It is to be recognised by appearances already figured and described, *vide* frontispiece, and must be treated constitutionally and locally, as described in the chapter devoted to this subject. Artificial inflation of the middle ear must be carried out, and when sufficiently accomplished, may be followed by attempts to reinstate the membrane by suction. Here I must confess that my experience of collodion applied externally for this purpose, as recommended by Dr. MacEwen at Cork, in a paper subsequently published in the *Brit. Med. Journal*, has disappointed me. The results in my hands have been almost nil, but I sincerely trust that my want of success is exceptional, as any well-approved means of accomplishing the object in view would be a decided gain to otological resources.

Side by side with the foregoing treatment, measures must be directed to allay the waves of irritation proceeding from a distance, especially from the stomach. In describing the analogous process seen when ear-ache occurs during dentition, I pointed out how lancing the gums was calculated to still the waves of vessel dilatation set up by the inflamed gums, and conveyed by way of the otic ganglion to the vessels of the ear. We must follow the same principle in the present instance. It will be found that usually there is in the subjects of so-called stomachic vertigo, a good deal of gastric disturbance, indicated by a furred tongue, flatulence, and uneasiness after meals. Frequently also, these patients are the reverse of discriminating in their diet. Thus the patient whose case has been quoted, though over

70, was very partial to meat, especially at supper. Such an indiscretion must be avoided, indeed it is best entirely to prohibit butchers' meat in these cases, and the entire diet must be regulated so as to give the digestive organs the lightest possible amount of work.

But our resources do not end with this kind of management. We possess in hydrobromic acid a remedy distinctly affiliated to the labyrinthine circulation. Its administration promotes the inhibitory function of the vessel area presided over by the inferior cervical ganglion, so that when given judiciously, *i.e.*, not thrown in simply because the symptoms exist to which it is antagonistic, but timed with such discretion to the general environment of the case, as a physician would ordinarily employ with regard say to giving steel, &c.—subject to these discretionary conditions, it will be found to act like a charm. At the same time it will relieve the pulsating tinnitus from which these patients suffer.

Before concluding the discussion of giddiness, a brief recapitulation of the facts, which I claim to have established respecting it, may not be out of place.

First in importance is the underlying principle, that the sympathetic ganglia constitute organs of correlation, by which distant regions become mutually related to each other, and which regions I have named "correlated areas."

Secondly, the application of this principle to the specific case before us, the inferior cervical ganglion, and the capacity which its correlations afford for explaining the phenomena of vertigo.

Thus, while anatomy shows that this ganglion gives

vaso-motor branches to the vascular systems of the vertebral and brachial arteries, and also sends communications to the heart and to the stomach, as well as to the brachial nerves, so bringing the equilibrating apparatus constituted by the semicircular canals into mutual relations with the arms, the stomach, and the heart; the actually *observed symptoms* of the disease indicate that one, two or all these regions, may manifest a departure from their normal condition in the individual who is the subject of it.

In the present chapter, I have added to these the symptom of impeded circulation in the upper extremities, indicated by congestive mottling of the hands in association with vertigo, thus including amongst its symptoms phenomena referable to all the recognised anatomical relations of this ganglion.

CHAPTER VII.

NOISES IN THE HEAD; THEIR ETIOLOGY, DIAGNOSIS AND TREATMENT.

PERHAPS no symptom is so generally associated with vague ideas as to its pathological import, or even as regards its location, as is tinnitus. In proof of this assertion, it will suffice to notice the following case from a work on aural surgery bearing the date 1876. The patient had suffered from distressing noises in his left ear for two years, and had undergone treatment for his heart, his lungs, his stomach, his kidneys, and his liver, "according as each of these organs had been diagnosed as the primary cause of the complaint;" and at the time the case was reported, he was suffering the "additional inconvenience of a large seton in the nape of the neck." An inspection of the ear revealed a large pulsating polypus, the beating of which was controlled by pressure on the left carotid.

The confusion surrounding this particular symptom is, indeed, not to be wondered at, seeing that all writers on the ear, from Wylde to Roosa, agree that it is impossible as yet to differentiate the causes on which the various forms of tinnitus depend. The subject is one, therefore, demanding investigation; the more so as it will be found to involve problems less easy of solution than that comprised in the instance just referred to. Doubtless much of the perplexity in question arises from the habit of referring the noises, when their origin is

not very apparent, to certain subjective conditions of the nervous system, more especially of the auditory nerve.

It will clear the ground I propose to traverse to dispose of this "subjective" hypothesis at starting. Not only because its retention is barren of any practical outcome, but it diverts the mind from an intelligent search after causes competent to explain the symptoms. A chief reason for rejecting it is found in the *persistent* character of tinnitus. Speaking broadly, any sensation possessing this character of duration may be regarded as distinctly objective, by which expression I mean that it depends on physical conditions, capable of being recognised by suitable methods of observation. The fact of these being obscure in their source, or difficult to demonstrate, cannot be held to remove the obligation patiently to investigate them, which is imposed upon those who undertake their treatment.

While not affirming that a subjective sensation is an absolutely impossible occurrence in diseased states of the economy, I should be disposed to limit these to the domain of mental phenomena, such as the seeing of absent or deceased persons, or the distinct hearing of articulate sounds when no one is present to utter them. Such auditory and optical illusions are sufficiently authenticated; their study, however interesting, is beyond the scope of the present discussion. Setting aside the question of delusive judgments on the part of the per-
cipient, it may confidently be affirmed of any impression occurring in the domain of the special senses, that if it persist, or is of frequent recurrence, it acknowledges an

objective cause. In view therefore, of any such sensation, our duty is to endeavour to delineate the exact mechanism by which it can be explained. This rigid mapping out of the factors of a symptom will usually be equivalent to the transference of it from the category of subjective to that of objective phenomena, and is the essence of every true advance in the science of medicine. It would be easy to multiply examples in proof of this statement, the following instance, however, will suffice to illustrate it.

A gentleman, otherwise mentally sound, became possessed of the impression that he was followed by a black dog: he could not reason himself out of this conviction, because whenever he assumed certain positions, the creature was palpably visible to his sight. The persistency with which he complained of his, to others, invisible companion, began to excite alarm amongst his friends on the score of his sanity, notwithstanding that it ought to have suggested a physical cause for the symptom, by placing it outside the pale of subjective impressions. At length the ophthalmoscope coming into vogue resolved the apparition, which it showed to depend upon some substance floating in the transparent media of the eye, and which assumed when in the field of vision, the shape and appearance of a black dog.

Such then is the standpoint from which I propose to examine the subject of tinnitus, my contention being that every sound heard by the patient has its counterpart in a condition competent to give rise to it. The determination of the character, and the methods of

recognising such objective states, together with the treatment suitable for each, are the subjects I propose to consider in this and the following chapters.

As regards the noises themselves, it will be conceded that among the minor ills of life, common alike to all classes of society, they constitute one of very frequent occurrence; while not rarely they become a veritable thorn in the flesh, pursuing the victim with relentless torture by night as well as during the day. The records of our asylums show that insanity occasionally results from this cause. Some patients tell us their noise resembles the boiling of a kettle; farm labourers who have to do with modern agricultural implements compare theirs to a " 'chine going round;" in some it is like the roar of the distant sea; or this, again, is varied with cracks and explosions; while many bear witness to hearing always a sort of rhythmical thud, as though their head were the anvil of some *unharmonious* blacksmith. As if to satirise the infirmity, a large proportion of its subjects are more or less deaf to the sounds of the outside world. Under such a complication of evils, it will cease to be matter of surprise when we find in the literature of the subject, the details of not a few patients who have sought in self-destruction a respite from their persistent torture.

Pursuing the clues suggested by certain anatomical and physiological relations of the ear, we are enabled to reduce these varying forms of tinnitus to a systematic classification. The following scheme will be found to include most of these, and its adoption will facilitate their study:—

OBJECTIVE CONDITION.		CHARACTER OF SOUNDS.
Labyrinthine congestion	Arterial.	Pulsating or puffing sounds.
" "	Venous, implicating sin- uses of brain.	Rushing, chattering, chirping sounds, usu- ally seeming to be located at a distance.
Anæmia.	Extra aural.	Tidal noises.
Aneurism.	" "	Pulsating noises.
Fluid in tymp. or Eust. tubes.	Catarrh of middle ear.	Bubbling and gurgling noises.
Congestion of memb. t. cavity of tymp. or Eust. t. or of all these to- gether.	Passive dilatation of ves- sels of middle ear fr. obstd. E. t. and change in shape of drum-head.	Tidal.
INDUCING		
Chronic non-supp. infl. of middle ear.	Exudations and hyperpla- sias with adhesions of moveable parts.	Tidal.
Gout. Syphilis.	Contraction of tensor tymp. muscle.	"
" Progressive deafness."	Otitis externa. reflex irrita- tion of tensor tymp. n. fr. otic ganglion.	"
Cerumen, fungi, foreign bodies in extl. canal.		
Eczema.		

*6145 3075
for description
of noise*

All the above may co-exist in the same patient at the same time, or may succeed each other, or be variously combined in different stages of the same case.

Commencing our examination with the first on the list, it is to be noted that the perceptive portion of the auditory apparatus, known as the labyrinth or internal ear (including the vestibule, semicircular canals, and cochlea), receives its vessels from the vertebral artery, a totally distinct source from that which supplies the more external or conductive parts of the ear. Two points suggest themselves in connection with this fact—1st, the very distant source from which this artery is derived—viz., the subclavian at the root of the neck; and 2nd, that the nervi vasorum by which its calibre is regulated come from the inferior cervical ganglion of the sympa-

thetic, which brings this vascular tract into some very special relationships having an important bearing on the phenomena of labyrinthine vertigo, of which tinnitus is one; it is therefore a point of great value in this enquiry. The veins which discharge the blood from the labyrinth pass into the superior petrosal sinus, and remembering that this small canal is directly connected with the two large receptacles of venous blood in the cranium—viz., the cavernous sinus in front and the lateral sinus behind,—it is easy to see how any obstruction to the venous circulation will proportionately retard the outlet of blood from the labyrinth.

Now, if the *internal auditory artery*, derived from the source above indicated, become dilated by diminution of its natural tonus (which is mediated by the sympathetic plexus just described), it will not only contain more blood, but will occupy more space than in its normal relations it should do. In the preceding chapter on Giddiness many circumstances conducive to this dilatation of calibre have been pointed out, and also that under these conditions of altered tension the vessels become enormously distended with blood. Remembering the extremely sensitive auditory apparatus amongst the nervous expansion of which its branches ramify, it is easy to understand that under these circumstances its beats become audible to the patient, and that they are synchronous with those of the heart. *Here, then, we have the indications for differentiating one set of noises.* When a patient tells us he has a knocking sound in his ear (generally this occurs on one side only at a time, though it may change sides), we know that the circulation in

his labyrinth is hyperæmic. As an example of this, I was told by a patient a short time since that he had a knocking noise in his left ear, and that he had counted on his watch eighty-four knocks or beats in a minute. Of course this corresponded with his heart's action. This form of *pulsating tinnitus* may occur in an otherwise healthy ear from causes connected with the vaso-motor system of nerves. When associated with deafness, as it often is, these pulsating noises may remain after treatment has removed any other abnormal condition. It is necessary to guard against the notion that all congestive conditions of the labyrinth are of necessity indicated by pulsating sounds, because the buzzing noises and stuffy sensations in the head due to taking large doses of quinine must, I believe, be referred to this part of the organ of hearing, but the usually undefined character of pulsation suggests, that the symptom is due to fulness of the venous as well as of the arterial system.

I treat this class of noises in the head by the internal administration of hydrobromic acid. The treatment in question arose out of Dr. Fothergill's observation that this drug antagonises the aural symptoms caused by large doses of quinine when administered with it. A closer examination of the symptoms accompanying the condition known as "chinchonism" will explain the *rationale* of the treatment of labyrinthine congestion by hydrobromic acid. As a reliable authority on this subject I quote the following description of the condition from Phillip's *Materia Medica*, a work which from its scientific character will repay attentive study:—
"When a patient is saturated with excessive doses of

quinine, he gets loud ringing noises in the ears, splitting headache, vertigo, amaurosis, sometimes even delirium. In animals a fatal dose of quinine has often produced convulsions, and paralysis of the hinder extremities. It would appear that the lowered sensibility of parts and the diminished muscular action are due not to direct paralysis of nerves, or to any interference with muscular irritability, but to a diminished reflex action. Irritation of the skin, followed by desquamation, occasionally occurs, and cases have happened in which the whole skin of a hand or even of a limb has come off like a glove. It further produces in some persons great acceleration of the heart's action, and of the respiration, so that the palpitation and hurried breathing cause much distress."

Reverting to the relationship which I have shown to exist between the vertebral artery and the inferior cervical ganglion, it will be seen that the symptoms just detailed are due to interference with the circulation of the tissue tracts supplied by the vessels *over which this ganglion exercises regulatory control*. It may further be affirmed that the toxic effect of quinine (very distinct from the absorption of small doses) is to annihilate the regulatory function of this vaso-motor centre, and by paralysing the vessels to the ramifications of which it is distributed, allows them to become gorged with blood. The symptoms detailed enable us to map out these districts. Thus, taking them in the reverse order to that of the quotation, we see in the disturbance of the heart's action an interference with the influence over that organ normally exercised by the lower cardiac

nerve, proceeding from the inferior cervical ganglion. In the desquamation of the skin of the upper extremity, especially of the hand, we trace the ultimate result of an over-supply of blood to this member in consequence of the distended state of the brachial artery and its branches, when its regulatory nerves, also derived from the same ganglion are paralysed by the drug. A similar state of things is seen in the area supplied by the vertebral arteries, whose equilibrium is likewise mediated by the ganglion in question. Owing to the great accession of blood resulting from this cause, to the medulla oblongata and cerebellum is due the disturbance noted in these nerve-centres, in which the labyrinth participates. To the consequent congestion of the latter organ are due the vertigo and tinnitus just referred to. It is worthy of remark that the labyrinth, an organ of special sense, being seated at the extreme periphery of this system of vessel area, is by a well-established physiological law the first to appreciate the indications of what is wrong in the patient's system. It thus acts like a sentinel to warn by the prominence of its outcry against the continuance of the drug, which, if persisted in, will induce those further congestive brain conditions soon to end in profound headache and delirium. Many other phenomena of great practical import are associated with the disturbance of the anatomical relationship thus briefly reviewed; their consideration belongs rather to the whole subject of vertigo, stomachic as well as labyrinthine, and has been already studied when treating of this subject.

Therapeutic experience has already empirically established a sort of affinity between some of the symptoms

akin to those of chinchonism, but referable to other causes (such as giddiness, headache, and ringing noises in the head), and the hydrobromic salts. Thus epilepsy has been long successfully treated, a condition corresponding to the convulsions produced by quinine poisoning in animals. The successful use of the acid, to relieve labyrinthine tinnitus is another piece of evidence in the direction indicated. Two important issues are deducible from the foregoing facts—viz., that quinine and hydrobromic acid are each specifically related to the tissue tracts whose circulation is regulated by the inferior cervical ganglion; and that therapeutically, these drugs are antagonistic, the former dilating, the latter contracting the vessels receiving their vaso-motor nerves from this ganglion. Physiologically, we are guided to the corollary, that distinct vaso-motor areas exist in the animal body, and that changes may take place in the circulation of such areas which are purely local in the first instance; that such changes are equivalent to local hyperæmias, or anæmias, according as the vaso-motor influences of the area are suspended or added to; and one or another of these conditions affords the clue to a vast number of pathological states; and, further, that any true system of therapeutics must be based on the recognition of the principle now enunciated.

Returning to the *treatment of pulsating tinnitus*, it had long been apparent to the writer that these noises had reference to the labyrinth, because they were so frequently associated with other symptoms of Menière's disease—giddiness, headache, &c.—the existence of which symptoms also establish its parallelism with

the tinnitus of chinchonism. Thus the inference became obvious, that the remedy for the latter would probably turn out to be equally curative of the noises produced by some forms of aural disease. The first case to which, in an experimental way, the hydrobromic acid was given for the relief of these pulsating sounds, confirmed the correctness of the above line of argument by its immediate and marked success. It may be taken as a typical one from over a score of others equally satisfactory. The patient had been treated for suppurative inflammation of the middle ear, with polypoid excrescences in the external canal, all of which objective conditions being removed, he still complained of throbbing sounds, with giddiness and headache, increased by stooping or exercise. Hydrobromic acid, in fifteen-minim doses in water, was prescribed every four hours. Relief to these latter symptoms was immediate, and they shortly disappeared altogether. It is satisfactory to note that the experience of other observers has amply verified this result, so that the drug may claim the position of a specific remedy for congestive labyrinthine conditions, providing always the auditory apparatus be first relieved of any well-marked morbid process, which, by its presence, might tend to keep up excessive vascular action.

The next class of tinnitus includes those phases of the symptom which depend on causes other than aural, and they are tolerably numerous. One of these has reference to the circulatory system at large. *Anamia*, whether due to exhausting discharges, direct loss of blood, chlorosis, &c., is accompanied with that peculiar

sound heard over the large vessels of the neck known as "bruit de diable." When it is remembered that the internal carotid passes very near to the labyrinth in its course through the temporal bone, while the internal jugular vein, in the jugular fossa, lies immediately below the floor of the tympanic cavity, it is not surprising that the patient should himself appreciate any abnormal sound occurring in them, when such sound is audible to an outside observer. For the same reason *aneurism* of the aorta, or its immediate branches, communicates by conduction its peculiar form of tinnitus, and especially is this the case in *intracranial aneurism*. In some cases of heart disease, especially in complete excentric hypertrophy, any extra exertion is attended with buzzing in the ears.

From the following case it would seem that an *overloaded state of the portal circulation* is sometimes associated with tinnitus, a circumstance that becomes quite intelligible if we bear in mind the facts of the relation of the veins of the labyrinth to the large sinuses of the brain, as noted above. A medical acquaintance had for several weeks experienced a dull ringing sound in the head, with a general feeling of malaise, and incapacity for any sort of head-work. He was induced to take a dose of Carlsbad salts, with the result of getting rid of all his symptoms, the tinnitus included. A further instance this of the auditory apparatus performing a sentinel-like office in the economy, warning of distant mischief.

That some noises have for their cause an overloaded state of the venous sinuses of the brain, or of the veins

connected with them, will be apparent from the following considerations. The most persistent buzzing and rushing sounds have occurred in patients in whom some peculiarity of the veins existed elsewhere than in the neighbourhood of the ear. I may instance one case where the tinnitus was coincident with a very large varicocele. Another in whom the superficial veins of the nose were congested and tortuous—and in neither did treatment produce any impression. The inference being that a corresponding but unrecognisable state of the veins pertaining to the auditory apparatus, was coincidentally present in these cases, which ordinary methods of treatment failed to influence.

Again, a patient informs me that after any departure from his usual moderate habits, such as “dining out,” &c., he would be awakened in the night by what appeared to him to be subdued conversation carried on under his bedroom window. Impelled by this impression, he at first got up and opened his window to ascertain the cause of this supposed talking, which always ceased when he assumed the upright posture. Directly he lay down again with the head resting upon the pillow the muttering recommenced. In this way he learned to recognise that he was himself the *producer* as well as the hearer of the sounds described.

Three elements appear to be concerned in the production of these noises: 1. Reduction of vessel tone, such as in some persons would follow an unusual dose of alcohol and tobacco, implying a retardation of the venous circulation over the area affected. 2. The influence of posture, adding a mechanical incentive to

engorgement, which becomes especially operative after the first factor has been established. 3. The effect of slight pressure, when the foregoing conditions are in operation, in obstructing the venous current, and throwing it back on the penultimate channels.

The following case indicates how these causes can affect an organ other than the ear, and illustrates the method in which they may incite tinnitus. A gentleman of middle age, whose turbinated bones approximated the septum very closely, the nasal region being otherwise healthy, had been for many years unable to breathe through the nostrils after lying down a short time. If he sat or stood upright the difficulty very quickly disappeared. He was an excessive smoker, and I had no difficulty in referring the symptom to the paralysing influence of tobacco on the vessel nerves of the region. The peculiar erectile character of the vascular tissue of the turbinated bones, being by this means deprived of its vaso-motor control, becomes amenable to the influence of posture whenever he lies down. The vessels then become turgid with blood, and swell up sufficiently to close the narrow breath-way, which is the normal state of the nasal meatus in this individual.

Apposite to the foregoing observations are the records of two cases, in which the noises assumed the character of a bird singing in the bedroom of the patients, sufficiently loud to awaken them from sleep, and which ceased or was greatly moderated when they sat up to detect the source of the annoyance. In both the symptom was distinctly traceable to tobacco-smoking, and disappeared with the moderation of the habit.

The influence of the third element, *pressure*, is illustrated in the above cases by the fact, that the noises were increased by resting the head on the pillow, the body being recumbent. If the patient lay on his back, the occipital emissary vein connecting the torcular herophili with the occipital veins of the scalp would be occluded, and thus an outlet of the mechanically distended sinus would be closed. If he lay with the *side* of the head downwards, similar pressure would be exerted upon the emissary vein passing through the parietal bone, and which relieves the longitudinal sinus through the superficial veins of the head. It must be admitted that these emissary veins are exceedingly minute, though probably not smaller than the effluent veins, which discharge the blood from the internal ear into the petrosal sinuses. The occlusion of the former will retain a certain amount of venous blood in the larger sinuses which is probably commensurate with that leaving the ear, the escape of which being retarded in consequence, must induce engorgement of the labyrinth.

Whether pressure be really a factor in the production of sounds under circumstances, such as those above portrayed, is not of so much moment as the establishment of a direct relationship between certain forms of tinnitus, and an engorged state of the venous circulation, especially of the intra-cranial sinuses. As far as my observation at present extends, I am disposed to refer to this cause, and the consequent venous congestion of the labyrinth, those noises which patients seem to hear at a distance, particularly if they assume a muttering or chirping character, and also those which

are referred to some part of the head other than the ear. If associated with headache, drowsiness, and other indications of intra-cranial congestion, the diagnosis would be confirmed. It was probably in cases of this kind recorded by the older writers, that bleeding has effected a cure. Thus we read of a patient with persistent noises in the head which defied every kind of treatment known at the period, who was permanently relieved by a copious bleeding from the temporal artery. Before having recourse to the lancet, every other recognisable source of the symptom should be eliminated. Then if purgatives failed, bleeding might be justifiable, though I have never yet adopted it.

The foregoing conditions, which are the common ground of every practitioner, suggest to the specialist how wide and general should be his grasp of the cases occurring in his particular department of practice. The fact, however, that murmurs, produced at a greater or less distance from the ear, are appreciated by this organ in the form of tinnitus, has an important bearing on the line of argument adopted in this chapter, as will shortly be apparent.

On analysing the very tangled residuum of noises which remain to be examined, they will be found to group themselves into two classes: one more or less intermittent, comprising a series of crackling, bubbling, or explosive noises; the other generally continuous, of a buzzing, singing character, which, making due allowance for the many fanciful descriptions of the patient, more often likens itself to the tidal sound produced by holding a shell to the ear than to anything else.

Respecting the first group of *gurgling* or *bubbling noises*, which the patient will compare to the bursting of bubbles in the head, these are due to the presence of fluid in the middle ear or the Eustachian canals. This mucoid or muco-purulent fluid, being formed in an air-chamber communicating with the throat, is subjected at frequent intervals to the passage through it of bubbles of air. Gases may also be generated in it, and escape in a similar way. The ready relief of these cases will depend upon the patency of the Eustachian tube, and the ease with which treatment can be applied directly through it to the ear; and this again will depend on whether the state of the naso-pharynx is such as to admit of the treatment being carried out. The following case in point occurred in the person of a woman who presented herself at my aural clinic a short time since. She had a most worn and distressed appearance, having had no sleep for three nights, in consequence of the intensity of the gurgling noises in her left ear. The nostril on this side was obstructed, owing to deformity of the bones, but, by giving a large curve to the catheter, the left Eustachian tube was entered from the right side. On forcing in air, much gurgling ensued, but when all the mucus was thus cleared away, the tinnitus entirely ceased. Of course the relief from such a palliative measure was only temporary, but it lasted nearly a week. Such a case would require a course of treatment directed to the cavity of the tympanum and the tube as well as to the post-nasal region. Solutions of carbonate of soda with carbolic acid, applied by means of the post-nasal syringe, as well

as injected through the anterior nasal orifices, are of paramount service here. Should the state of things just described co-exist with perforation of the drum-head, treatment is much facilitated, it being comparatively easy to inject suitable lotions by the external meatus right through the middle ear to the throat. It is often surprising how much muco-purulent secretion may in this way be washed out of the cavity of the tympanum and the mastoid cells communicating with it. The further treatment of these cases resolves itself into that for chronic suppurative inflammation of the middle ear.

When the *membrana tympani* has been *chronically diseased*, it sometimes loses its elastic character, and becomes thin and harsh like parchment. In this state its movements are, according to Hinton, attended with creaking noises very annoying to the patient. In other cases a portion of mucus has become inspissated and adherent to the ossicles, or it may even form a film over the tympanic surface of the membrane, causing the patient to be very deaf. This may at length be ruptured, either spontaneously, or by the action of the intrinsic muscles on the parts to which it is adherent, such a rupture being attended with a very audible report to the patient, who henceforth is much improved in hearing power. Similar as regards its origin was a somewhat unusual symptom complained of by a gentleman who consulted me on the subject. He said there was "something loose in his head," and that he felt it roll about whenever he moved suddenly. There was no reason to doubt this statement, and as he had had

trouble in his ears earlier in life, it seemed probable that a past attack of tympanic catarrh had left behind it a legacy of unremoved secretion, which had gradually dried up, and, being unattached, moved about in the cavity of the drum with the motions of the head. Acting on this supposition, he was given a powerful insufflation with an ordinary Politzer bag. Immediate cessation of the symptom followed this proceeding, and as the relief was permanent, it is probable that the force of the current of air drove the loose particle into a corner and wedged it there, to the great relief of its possessor.

I have next to consider that group of noises which have a *singing* or *buzzing* character; they are more or less constant in their duration, and though assuming many variations, are here for the sake of convenience, classified under the head of *Tidal* noises. They often co-exist with the intermittent gurgling noises already examined, and even sometimes with the pulsating sounds of a rhythmical nature—in fact all these classes of noises may be present either at one and the same time, or at different periods in the progress of the same case.

As already intimated the hypothesis which it is my object to establish, is based on the principle that for *every noise experienced by the patient there exists a definite objective cause*. The factors which are mainly instrumental in the production of the class of sounds now under review may be referred either to contraction of the intrinsic muscles of the ear; or to the rushing of an increased flow of blood through the relaxed and

dilated vessels of the cavity of the tympanum, setting in vibration the adjacent air, or, as will shortly be explained, other vibratile structures capable of responding to such influences. All these causes may co-operate in producing the symptoms of which the patient complains, because the congestion of the middle ear obtaining in the latter state is calculated to irritate the muscles, and excite them to spasmodic action, at the same time the contraction thus induced will aggravate the original disturbance of the circulation. So that these abnormal conditions of the middle ear by reacting on each other tend to perpetuate the disease, and constituting as they do a large part of the morbid phenomena of chronic non-suppurative inflammation of the middle ear, it is not difficult to understand why this particular form of ear disease comes to be the *bête noir* of the aurist.

First I will examine the sounds resulting from *muscular contraction*. If a person lying with the side of his head on a pillow tightly clench the jaws a sound is heard which closely resembles that produced by holding a shell near the ear. It is due to the contraction of the muscles which close the jaws, and is said to be of universal occurrence whenever a muscle contracts strongly, but which is audible to the experimenter in this case owing to the proximity of the contracting muscles to the auditory apparatus. Hence it will be apparent that if the sound in question can be heard when situated without the ear, the inordinate contraction of muscles situated actually within the hearing apparatus must even be more audible. That the or-

dinary contraction of the tensor tympani and stapædus are not thus appreciated, is within the experience of every person possessing healthy ears, it requires for its production an inordinate or spasmodic contraction due to some irritation of the muscle from coexisting disease, or of its nerve, to produce such a vibration of its fibres as would constitute an audible note. The possibility of its occurrence was first suggested by Laennec but the points by which its presence may be diagnosed are of quite recent date and require attentive study. They have been carefully investigated by various continental authorities foremost among whom are Weber-Liel, and Gruber. The latter was the first to point out that the tendon of the tensor tympani is inserted into the anterior surface of the handle of the malleus, as well as into its inner angle. This fact has an important bearing on the position which the manubrium will assume when subjected to the strain of the muscle which acts upon it. Under these circumstances, the bone will undergo a kind of semi-rotation on its transverse axis, the effect of which is, that while the distal end of the manubrium is directed inwards, the upper end of the malleus bulges against the membrane, throwing the two plicæ semi-lunares into marked prominence, at the same time the processus brevis is brought into view; while the upper part of the manubrium stands out boldly in relief, its distal end retreats towards the inner surface of the tympanic cavity, so that when observed from the meatus the process is seen shortened. The anterior segment of the membrane is greatly retracted, appearing to fall away from the

plane of the rest of the membrane in the direction of the cavity of the tympanum. In determining the diagnosis of contraction of the tensor tympani it is necessary to eliminate another condition of the manubrium mallei which is not infrequently met with, but which does not appear to have attracted the attention which the frequency of its occurrence would justify. It consists in the displacement of the manubrium from its obliquely vertical position, into a more or less horizontal one, so that it comes to be parallel with, and almost close to, the margin of the posterior plica semi-lunaris. The assumption of such a position as the result of muscular action cannot as yet be considered established; it would seem to point to a mal-position of the tendon, the result of inflammatory adhesions contracted by it in the progress of grave disease of the tympanic cavity, with probably destruction of the axis ligament and partial dislocation of the malleo-incudal articulation.

In attempting to differentiate this particular condition we must not lose sight of the fact, that cicatricial contractions and adhesions are frequent sources of displacement of the position of the manubrium mallei: when, however, it is due to muscular action the entire membrane is usually mobile, and is more or less capable of restoration to its normal plane, by inflation through the Eustachian tubes.

While writing these lines I have had under inspection a patient whose membrana tympani is so completely retracted, that it rests upon the promontory which is distinctly seen through it—yet he hears no noises. In this case the manubrium retains its normal obliquely

vertical direction, its distal end being simply drawn inwards by the retracted membrane. But where the retraction is due to muscular action the characteristics already noted will be apparent. Where then the tidal noise exists and associated with it, the membrana tympani presents the foregoing appearances, we may safely postulate a condition of spasm in the muscle in question. And it is exactly in these instances, that the simple proceeding of exhausting the air of the meatus with a pneumatic speculum by pulling upon the tensor muscle, and so reducing the spasm, temporarily relieves the tinnitus dependant upon it. The reduction of spasm by extension of the contracted muscle, will suggest many analogies in surgical practice. It is important to notice here that most writers attribute the cessation of the noises occasioned by the use of the pneumatic speculum, under these circumstances, to the fact that pressure is thus taken off the endolymph which the retraction of the membrane is supposed to imply.

But the whole of my argument is against such pressure being a vera causâ of tinnitus.

Were it otherwise, that is to say, if retraction of the drum-head constitutes pressure on the endolymph, and such pressure necessitates the production of a subjective noise—surely no instance could better exemplify these conditions than the one above quoted.

Yet though here the collapse was complete, there were no sounds; such cases of retraction without spasm of the tensor tympani indeed are of daily occurrence; they result for the most part from closure of the Eustachian

tube, in which case tinnitus is not necessarily present, and if it do exist, it is from some other cause than compression of the intra-labyrinthine fluid. Such pressure may cause giddiness and tendency to fall, phenomena which coexist with deafness, but any concurrent sounds acknowledge a totally different, and as already insisted upon, a distinctly *objective origin*. That is to say, for a sound to be heard a sound must exist.

Under this head also, come a number of instances where very small foreign bodies get on to the membrane of the drum, and indicate their presence mainly by the disproportionately severe tinnitus to which they give rise.

The following is a case in point. An iron-moulder had several small black patches, consisting of foundry dust and secretion, adherent to the drum-head, with concomitant noises of the most distressing character, all of which disappeared with the removal of the offending matter. Instances are not rare in which one of the stiff hairs usually found about the orifice of the meatus, gets lodged upon the membrane with a like result as regards the production of tinnitus.

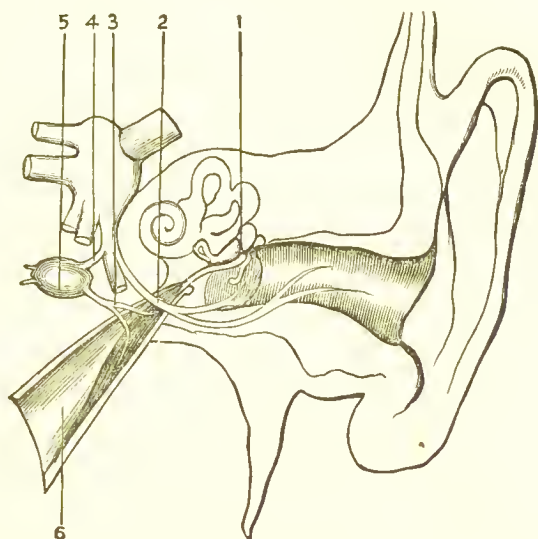
Then there is the case of the classical louse, whose peripatetic wanderings over the drum-head were accompanied with as much noise to the sufferer as if he were standing close to the monster drum at a popular concert. Now it is important to bear in mind that in these cases, tinnitus, though a marked symptom, is not the only one, there being usually a strong sense of horror pervading the patient, and at the same time so much giddiness, that occasionally he is compelled to fall to the ground.

These points are graphically illustrated in a instance related by Wylde. He states : " I remember being out shooting in a plantation many years ago with a friend who suddenly exclaiming, 'oh ! an ear-wig !' and throwing aside his gun, fell on the ground, making the most piteous moans, and rolling about in convulsive agony. Finding that some small insect had got into his ear, I procured some water from a neighbouring ditch and poured it into the meatus ; and as I watched for the result, a little animal, well known among anglers as the hawthorn fly, crept out, and the gentleman was immediately relieved."

These associated symptoms are of paramount importance, as they indicate the true cause of phenomena. The accompanying diagram will aid their elucidation which is as follows:—the membrana tympani and inner part of the meatus are exquisitely sensitive, a circumstance which is due to their being highly endowed with nerves from the auriculo-temporal of fifth, (*vide* Fig. 16). This nerve, it will be remembered, supplies an offset to the otic-ganglion (4), and this ganglion (5), supplies the nerve to the tensor tympani (3), or rather, as I should prefer to describe it, the branch of the auriculo-temporal destined for the tensor tympani passes through the otic-ganglion on its way to the muscle. Now it is a trite physiological axiom, that when the peripheral distribution of a sensitive nerve is irritated, reflex spasm is excited in the muscles supplied by the same nerve.

It is quite clear that such a set of phenomena are established when the drum-head is tickled or otherwise

FIG. 16



1. Tendon of tensor inserted tympani muscle into manubrium mallei, after crossing tympanic cavity.

2. Brs. of auriculo-temporal nerve distributed to external auditory canal and membrane.

3. Branch from otic ganglion to supply tensor tympani muscle.

4. Br. from auriculo-temporal to 5.

5. Otic ganglion.

6. Eustachian tube containing tens. tym. (represent diagrammatically).

irritated, in consequence of which irritation the tensor tympani becomes spasmodically convulsed, the vibrations of its fibres causing the *sounds* of which the patient complains, while the retraction of the ossicles upon the membrane of the vestibule (foramen ovale) which accompanies this action, produces such disturbance of the equilibrating apparatus constituted by the semi-circular canals, that the patient not only becomes *giddy*, but has a strong tendency to topple over.

It may still perhaps be regarded as a moot question, whether, when every other factor is eliminated, pressure on the intra-labyrinthine fluid is ever *per se*, capable of giving rise to sounds which in such a case might fairly be called *subjective*. In discussing the etiology of pulsating tinnitus we saw how a surcharged state of the arterioles of the labyrinth communicated their throb to the contiguous nerves of audition, and so gave rise to the symptom.

It is possible that pressure exerted from without upon the endo-lymph, by crowding the delicate elements, including the capillaries, of the perceptive apparatus of the cochlea upon each other, may be attended with similar results, because compression of the vessels by increasing the resistance to the passage of blood through them would occasion the rushing noise complained of where such pressure exists. Even then the symptom must be regarded as an objective one. This is doubtless the condition which exists in Menière's disease, due to pressure upon the fluid contents of the labyrinth by morbid processes going on in the tympanic cavity.

The noises heard under these circumstances cannot be compared to the luminous image produced by pressure on the globe of the eye, and known as *phosphenes*, and which are seen as long as the pressure is kept up. These appearances may possibly be regarded as subjective phenomena, because the luminous effect thus occasioned has no actual existence outside the state of the optic nerve or the retina, induced by the pressure. But we cannot accept such an explanation as applicable to any considerable proportion of cases of tinnitus, because

of the persistency of the sounds, which often extend over many years; for it is difficult to imagine that sufficient pressure could be exerted to give rise to the tinnitus, without procuring speedy disorganisation of the auditory nerve. This means absolute deafness and is the usual course of events in Menière's disease; it bodes ominously for the patient.

I call attention to these points before proceeding to the next group of noises in order to insist on the importance of an early diagnosis of the causes of tinnitus, and the issues towards which they tend. The cases already dealt with are for the most part amenable to treatment. The hyperæmic conditions of the middle ear about to be considered are doubtless more difficult to deal with, but the necessity for treating them becomes more urgent in proportion as we recognise their tendency to pass into the proliferating and disorganising processes to which reference has just been made. For it will be an advantage to arrest the progress of the disease even though the mischief already accomplished cannot be undone. The triumph of the aurist in this event may not be very striking, but it is not the less a substantial gain for his patient. Syphilitic affections of the middle and internal ear are practically undistinguishable from the foregoing, except by such light as their history may afford.

These preliminary observations bring us to the last group of sounds recognised in the foregoing classification. It includes by far the largest number of cases of tinnitus. The ordinary singing in the ears met with in nearly every instance of acute mischief in these

organs, and in a large proportion of the chronic ones, belong to this group. Such of them as are not explained in the previous paragraphs, are *referable to a hyperæmic condition of the vessels of the meatus, middle ear, or Eustachian tube*, or of all these regions combined. It is necessary at this point to recall the following anatomical relations of the blood-supply of the regions involved in our inquiry. For this purpose it will be sufficient to state that the vessels of the external canal, membrana tympani, and middle ear, are continuous to a considerable extent *from the outer side*, through the stylomastoid branch of the posterior auricular artery, while the Eustachian tube receives its blood from the ascending pharyngeal and inferior palatine arteries, branches of which it transmits along its course to the cavity of the tympanum. The point I wish to emphasise as bearing on the origin of these noises, is that the cavity of the drum is furnished with blood-vessels, *continuous on the one side with the external meatus, and on the other with the Eustachian tube*.

Perhaps the simplest form of the kind of tinnitus now under review, occurs when *cerumen* has accumulated for a long time in the meatus. It is then almost always associated with ringing noises, which Kramer attributes to pressure on the chorda tympani as it crosses the drum-head. Though Kramer attempts no further explanation of the *modus operandi* of this cause, it could only become operative on the supposition of a transference of the irritation from the chorda tympani to another branch of the seventh nerve, viz., that supplying the stapædii muscle, the violent contractions of which consequent thereon giv-

ing rise to the symptom complained of. One objection to this view is that giddiness commonly accompanies an accumulation of cerumen, which the action of the *stapedius* would antagonise, for being a *laxator tympani*, its contraction would prevent pressure on the labyrinth. It is therefore more probable that spasm of the *tensor tympani* is responsible for some of the noise audible under the circumstances, and this would be excited reflexly through irritation by the ceruminous mass of the sensitive branches of the fifth distributed to the drum-head, as already described.

This latter view accounts also for the attendant giddiness, as it causes pressure directly on the labyrinth.

The true element in the permanent causation of the sounds becomes evident when the obstruction is removed from the canal. If it and the membrane be then subjected to searching examination, some part will invariably be found injected, and from what has been said of the community of vascular supply on either side the drum-head, it is quite certain the congestion extends also into the tympanic cavity.

The various forms of mycelium, penicillus, aspergillus, and other fungi which occasionally make their habitat in the external meatus are also accompanied by these noises. But when the canal is cleared, it will invariably be found in a hyperæmic condition, so that the same explanation of the tinnitus holds good in these instances as in that of inspissated cerumen.

Confirmative evidence of this view of the *hyperæmic origin* of certain noises is afforded by a case related by Tröltsh, in which the irritant was seated at the opposite

end of the auditory passage, viz., at the mouth of the Eustachian tube. The patient in this case complained for years of a continuous sound in one ear, and of a sensation in the pharynx as if a hair had got into his mouth. After the man's death a grain of barley was discovered projecting from the pharyngeal orifice of the tube and extending into the osseous portion.

In this instance of a foreign body impacted in the inner orifice causing tinnitus, we have the counterpart of the same condition at the *outer orifice* producing this symptom. As we have seen, a corresponding continuity of blood-supply exists between either passage, and the tympanic cavity. In the former therefore as in the latter the presence of an irritant gives rise to an increased flow of blood to the ear, the vibrations in the adjacent air thus induced being appreciated by the auditory nerve as a murmur. At the same time it may well be granted that the presence of a foreign body in the Eustachian tube, close therefore to the situation of the tensor tympani muscle, may occasion its contraction, and thus introduce a duplex element into the causation of those sounds which acknowledge a Eustachian origin.

By far the most frequent incentive to hyperæmia of the middle and external ear is occlusion of the Eustachian tube, from extension of pharyngeal or post nasal catarrh to its lining membrane. Neuroses of the muscles of the tube will also, as explained in the chapter treating of this subject, give rise to the same condition. It is one of the best ascertained and most elementary facts of aural science that the prevention

of the normal ventilation of the tympanic cavity by any cause is attended by disappearance of air from that space, with the consequent collapse of the membrane as it yields to the atmospheric pressure from without, when the counter-balancing support of the internal column of air derived from the Eustachian tube is withdrawn. But this withdrawal of air from the tympanic cavity involves also a *disturbance in the statical relations of the blood vessels* of its lining membrane and which, in consequence of the vacuum thus occasioned, become enlarged in calibre and distended with blood. The region thus assumes a state of passive congestion from this mechanical cause alone, a circumstance which is too often overlooked. The hyperæmia in question will extend by continuity of blood supply to the vessels of the manubrium, of the semi-lunar folds, and of the external auditory canal. It is not inflammatory, at least in the early stage, and affects the venous more than the arterial circulation.

Bearing in mind that it is to the vibrations excited by these congested vessels that tidal noises are referred, the foregoing consideration suggests one among the sources of failure of treatment to remove these very persistent sounds. Thus it might be supposed that if an obstructed Eustachian tube can induce all these phenomena its restoration to the normal state should remove them. But experience teaches that it is only when such patients present themselves much earlier than is their wont, that a satisfactory result as regards the tinnitus attends the resumption of the tubal function. The reasons being that the long dilated

blood vessels do not readily resume their normal tone, but tend to keep up their congested state; also the lengthened continuance of the acquired concavity of the drum-head has a tendency to impart a permanent character to this condition, for the tissue in question is devoid of elasticity; and further the chances of adhesion taking place in the acquired position increase in proportion to its duration.

As regards the character of these *tidal* sounds they very closely resemble the noises heard in shells, and "which poets feign, and the vulgar believe, to be the noise of the distant sea.

Shake one, and it awakens; then apply
Its polished lips to your attentive ear,
And it remembers its august abodes,
And murmurs as the ocean murmured there."

With the view of determining the physical conditions upon which tidal tinnitus depends, it will be helpful to briefly examine the nature of these shell noises which so closely simulate those heard by our patients.

According to Martineau, "Chapters on Sound," it is not necessary to employ a shell to elicit these noises, he says "a cup held over the ear gives the same sound. It is caused by the throbbing of the blood in passing through the viens of the ear together with other little noises not loud enough to be noticed when they are by themselves. But these very faint sounds when they enter the cup or shell make the air inside resound gently in reply to such of them as are tuned rightly." It is easy now to understand why shaking the shell should be had recourse to for the purpose of "awaken-

ing" the noises, as the muscular exertion of the act by quickening the circulation generally, and especially the flow of blood through the veins, will occasion more sound to accompany its course through the containing vessels—a condition that is rendered unnecessary as being already fulfilled, in a patient with tidal tinnitus. Here I venture to suggest, for the present quite tentatively, another factor in the causation of these sounds, arising out of the altered state of the drum-head, usually found associated with the condition under review. It is as follows: the change effected in the position and relations of the manubrium mallei converts it into an instrument capable of picking out certain of the vibrations occurring in its immediate neighbourhood, and of vibrating itself in response to such as are rightly tuned to excite this vibration. Just as when one sneezes in a room where there is a piano, out of the multitudinous noises of which the sneeze is made up one is rightly tuned to the pitch of a particular string in the musical instrument, which is henceforth set in motion by the sound, and gives forth its own note accordingly.

Now if we observe carefully the shape which the drum-head assumes in a large proportion of cases where tidal noises exist, it will be seen that it by no means presents the character of a uniform cupping. It will be found to be made up of two unequal depressions. First, that formed by the posterior segment which ends abruptly in the anterior border of the hammer handle. Second, that formed by the anterior segment which is more marked than the other, and

appears to retreat inwards, so that its plane is placed much deeper than is that of the posterior segment. Thus we have two distinct conchoidal surfaces sharply separated by the manubrium, the anterior aspect of which stands out as a clearly defined ridge.

The reason why the manubrium does not fall inwards along with, and to the same extent as, the membrane into which it is inserted, depends upon the construction of the malleo-incudal joint. For while this allows of a tolerably free movement of the head of the malleus forwards, without at all affecting the incus, there is but the very slightest room for its inward excursion, this being arrested by the cog-like arrangement of the joint provided to limit its movements in this direction. Thus it happens that while the membrane itself yields to the pressure of air from without, the manubrium is arrested in its inward course, causing the membrane to belly on each side of it, just as a sail would do in a breeze if a taut rope were stretched across it.

The handle of the hammer bone thus thrown into prominence is held in a state of extreme tension, but not of absolute rigidity. It may, therefore, be compared to the string of a piano tuned to concert pitch, and capable of vibrating to such properly tuned notes as strike against its projecting surface. Such vibrations, if they do occur, would be immediately conducted to the perceptive apparatus, and would naturally confuse, and in some instances destroy, sounds audible to a healthy ear.

While therefore all the mechanical requirements for such additional sources of sounds are supplied by the

conditions just traced, their dependence upon these is confirmed by certain peculiarities of the sounds themselves. Thus it is common to be told by patients when describing their noises, that they are subject to many variations in the pitch or intensity of the note; usually they are conscious of two sounds at least, one being farther off like a distant waterfall, or the wind as it passes through the branches of a tree; while another of a decidedly hissing or buzzing character appears to the subject of them to be located in the ear. This latter and sharper sound is liable to rapid changes becoming louder suddenly, and again subsiding into the usual key. This change is accompanied by a sense of movement in the ear, and is explained by a contraction of the tensor tympani having moved the chain of ossicles, and with them the manubrium, of course altering its tension and changing its note, but which lapses into the usual tone as the contraction relaxes, and the manubrium returns to its former position.

Again, confirmative evidence of the correctness of this hypothesis is furnished by the fact that when a permanent opening exists in the drum-head, it is rare for these noises to occur. Also, if the manubrium be completely retracted, as when it rests on the promontory or some other part of the inner wall of the tympanic cavity,—a condition which indicates serious lesion of the malleo-incudal joint, or displacement of the incus as well as of the malleus,—tinnitus is rarely complained of.

The foregoing considerations, as already hinted, afford a physical basis in support of the statement

frequently made by patients, viz. that it is the noises that make them deaf. For when a sound enters the ear and meets therein with vibrations corresponding to its own, the one set antagonises the other, consequently neither is heard. Such sounds are no doubt frequently emitted in the course of conversation, especially if carried on in a low tone. It is under these circumstances that patients to whom reference is made, complain of deafness, which, though not very severe, is sufficiently marked to occasion annoyance.

We are now in a position to understand how it happens that in the large and tedious class of cases of deafness included under the head of chronic non-suppurative inflammation of the middle ear, which for the most part have a pharyngeal origin, we so invariably meet with tinnitus, respecting the causes of which inspection affords no very obvious clue, but which the foregoing observations refer to distinctly objective and physical conditions. It is in these instances that the best directed endeavours of the aurist to relieve the sounds prove so frequently abortive: it is in these also that patients so pathetically implore us "to do something for their noises, not to mind about the deafness, they have given that up long ago."

That these cases are not, however, quite hopeless the writer's experience has amply shown, considerable benefit having followed the use of remedies directed to subdue the hyperæmic cause of tinnitus, and also to correct the abnormal physical relations of the conducting apparatus associated with it. It is necessary to remember that many other conditions dependent upon the

congestion are superadded to it, and must be treated accordingly; while the confined space in which the morbid processes take place, and the difficulty of gaining access to them, are further obstacles to the treatment.

CHAPTER VIII.

DEAFNESS, GIDDINESS, AND NOISES IN THE HEAD: PRINCIPLES OF TREATMENT.

IN the preceding chapters the subject of treatment has been referred to in connection with the particular symptom then under review. It remains to supplement these observations by a more general consideration of the entire subject, in order to embrace such points as have been hitherto passed over, or only casually glanced at. Perhaps there is no form of ear disease in which one or other of the symptoms discussed in the foregoing pages is not a more or less prominent feature. They are frequently all of them present at the same time, associated with grave lesions of the auditory apparatus; while it is possible for any one of them to exist temporarily from simple functional derangement, without any organic change in the tissues of the ear.

It usually happens that the subjects of these symptoms complain chiefly, if not entirely, of the *noises*. They will seldom allow they are deaf, though admitting they may be a "little hard of hearing," and the existence of *giddiness* is only elicited after close investigation. Even when its presence is admitted it is usually referred to some passing stomach derangement. That this may be the case has been abundantly indicated in the chapter on vertigo, yet even then the symptom is none the less aural in its relationships, inasmuch as it is due to reflex disturbance of the equilibrating function of the laby-

rinth, and, if a persistent symptom, is probably always associated with a greater or less degree of lesion of the middle ear. If the patient have passed the prime of life, this tendency to ignore the presence of both vertigo and deafness is usually very manifest, probably from his having an idea that such conditions foreshadow the approach of mental decay. The *noises*, however, are too palpably annoying to meet with such neglect, and for these relief is usually sought. In such cases a careful examination to test the hearing power of the patient, will seldom fail to disclose a varying degree of deafness, sometimes of considerable extent. Obviously, such an examination should never be omitted.

The reader who has followed the argument adopted in the preceding chapter, will see that it is in his power to reassure his patients respecting the by no means unreasonable apprehensions, just alluded to. For he will now be able to show him that his disorder is localised in a region external to the brain, the removal of which, beset with difficulties though it be, will leave him with his mental faculties unimpaired. At the same time the fact must not be lost sight of, that the long continuance of altered tension of the auditory nerve, implying as it for the most part does, important modifications of the blood supply of the nerve centres nourished by the vertebral artery, must eventually lead to such tissue changes in them, as seriously jeopardise the well being of the economy. Hence the paramount importance of regarding these symptoms from the wider point of view insisted upon in these pages, and to their early treatment on the principles herein discussed.

These remarks will explain why, in dealing with the general question of treating giddiness and noises in the head, whether associated with deafness or not, it is useful to regard them as integral parts of a common disorder, and this course will be followed in what remains to be said on the subject.

In the first place, attention should be directed to the removal of any *exciting cause of congestion in the post-nasal and adjacent regions*, before any progress can be made with the case. Excessive smoking and drinking are pre-eminently calculated to encourage such a condition, and must be discontinued or greatly reduced if success is to be effected by the treatment. But apart from any other consideration, it is a noteworthy fact that tobacco smoking is of itself a source of tinnitus, which it is capable of establishing when no other lesion, except that caused by the herb itself, exists to account for it. What the nature of this lesion is will be gathered from the following account of the symptoms of an overdose of tobacco smoke on the system, before it has become by practice inured to its use. These have a double bearing on our subject, inasmuch as they illustrate certain physiological processes of the vaso-motor system, called into operation by particular drugs, to some of which allusion has already been made, and which have their counterpart in the conditions frequently established by disease—and because these conditions are specially observable in the regions of the throat, ear, and nose.

The first effect of a *strong dose of tobacco smoke* is *salivation*, which arises thus: the specific impression of

the drug is conveyed by the afferent nerves from the mouth to their vaso-motor centre, and is thence reflected to the vessels supplying the buccal mucous membrane in the form of waves of vessel dilatation. This means more blood and more secretion. As the vaso-motor nerves implicated in the act are derived from the upper cervical ganglion, the effect is gradually extended to other vessels supplied with nerves from this subcentre, until an area is involved which is almost co-extensive with that receiving its blood from the branches of the two carotids. The successive implication of these new tracts is indicated by throbbing in the temples, fulness, and feeling of tightness in the head, as though a band were stretched round it. Succeeding these premonitory symptoms there will ensue lachrymation, redness and irritation of the conjunctivæ, flow of mucus from the nose, indistinctness of vision, giddiness or ringing noises in the ears. Each accession of a fresh symptom indicates the extension of the dilating influence of the drug over the vessels of a new area, mediated by the sympathetic ganglion.

If now the smoker lay down his pipe and hold some iced water in his mouth, or better still chew a fragment of camphor, these symptoms will gradually pass off, the latter drug being, as already stated, the physiological antagonist of tobacco. But if intent on pursuing the experiment to the bitter end, the smoker continue his pipe, there will occur palpitation, and uneasiness in the cardiac region, indicating the descensive implication of other ganglia, notably those from which the cardiac nerves arise. In this connection it is instructive to

note that in some animals nicotin "possesses the power of paralysing the terminations of the inhibitory fibres contained in the trunk of the vagus, without affecting the intrinsic inhibitory ganglia of the heart." (Handbook for the Physiological Laboratory. p. 280): aching of the arms (see page 113 *et seq.*); eructation, nausea, and vomiting, until eventually the lower bowel participates in the influence of the drug and its contents are voided; the patient now passes into a state of collapse, and is absolutely unable to stand. The latter condition denotes the implication of the ganglia supplying the splanchnic nerves, and recalls the phenomena attending their division, a feeble imitation of which is afforded in the early stages of cholera.

Now while the foregoing is the course of symptoms in a typical case of tobacco poisoning, there can be no doubt that habitual smokers who affirm they experience none of these effects, do notwithstanding manifest some evidence of the physiological action of the drug in the induction of what may be termed a very mobile state of the vaso-motor centres primarily affected by it, rendering them peculiarly susceptible to any superadded disturbing influence. In this way may be explained the peculiar liability to post nasal catarrh, and noises in the ears to which smokers are liable, as well as the difficulty of getting rid of these troublesome ailments as long as the habit is continued. It is moreover probable that this peculiar *mobility of the vaso-motor centres* is transmitted by great smokers to their offspring, giving rise to the tendency to ear disease, croup, and extreme liability to nasal catarrh seen in the children of some

families. I entertain very little doubt that there exists a tobacco cophosis just as there is a tobacco amaurosis. Where excess in alcohol obtains as well as of tobacco, all these proclivities will be intensified: the effects on the succeeding race will then be most manifest. The experience of every medical man in extensive family practice will justify these observations.

The practical bearing of these facts on the subject of tinnitus is twofold. First, the very obvious inference in view of a case of obstinate noises in the head occurring in a smoker—that the habit be discontinued, for it has not unfrequently happened that this simple expedient has sufficed to get rid of the annoyance. And secondly, it supplies a therapeutic suggestion for the treatment of cases in which the symptom exists apart from any such objective cause. Reverting to the remark that *camphor* exercises a restorative influence over the suspended inhibition of the sympathetic ganglia induced by an overdose of tobacco-smoke—and bearing in mind its undoubted efficacy in certain forms of diarrhoea, and even in mild cases of cholera—remembering also its extensive use by some practitioners for arresting the progress of cold in the head—we have an accumulation of evidence in favour of the probable value of camphor in that form of tinnitus, which, according to the hypothesis now advanced, acknowledges a hyperæmic state of the circulation of the middle ear as its cause. It will be seen that this conclusion is reached by following a line of argument similar to that which proved fruitful of results in the case of hydrobromic acid and quinine. It is necessary

for the effective use of camphor that suitable cases be selected, those viz., which have the characteristics of chronic non-suppurative inflammation of the middle ear, and also that it be applied locally. The latter condition will be best accomplished by inhalation after the Valsalvan method, and even if the Eustachian tubes do not at first readily admit the vapour, its use will largely tend to restore them to a healthy state, and so secure their patency. The following formula will be found to answer the required conditions.

R. Camphoræ, gr. xxxvj.
 Sp. Vin. Rect 3 ij. Solve et adde
 Tr. guaiac. ammoniatæ 3 x. M.

A teaspoonful to be added to a pint of nearly boiling water, the steam to be inflated by the Valsalvan method twice daily.

The *salts of ammonia* have long had a reputation for reducing inflammatory or congestive conditions of the nasal mucous membrane, and also of that lining the post-nasal space. The *hydrochlorate of ammonia* is especially known in this respect as it enters into most of the washes applied to this region, and in combination with bicarbonate of soda forms a very useful solvent of scabs and retained mucus in the nasal cavities. It is further credited with exerting an alterative effect on the mucous membrane. Two drachms of each of these salts dissolved in a pint of water forms a suitable solution for the purpose, to which occasionally it may be desirable to add a few drops of Condyl's fluid or carbolic acid. It may be applied by means of a spray apparatus

either through the anterior nasal orifices ; or post-nasally, by introducing a suitably-curved instrument behind the soft palate : or, the post nasal or the anterior nasal syringe may be used instead. The nasal douche is another very effective method ; and it is frequently sufficient to direct the patient to sniff the fluid up the nostrils from the palm of his hand, or from a spoon. Each of these methods of irrigating the nasal region has its advocates. I have found it expedient to dispossess one's mind of prejudice in favour of any particular plan. In a great number of cases either method will answer the purpose, while in others annoyance will be caused by all, such as headache, neuralgic pains in the face, &c., these accompaniments may, however, be usually avoided by using the solution tepid rather than quite cold.

From an *aural* point of view the object to be attained is two-fold : first, to remove obstructive secretions from the Eustachian tubes, and secondly, to reduce those hyperæmic and hypertrophic states of their lining membrane which, by increasing its bulk, tend to occlude the canals, and so hinder the due access of air to the tympanic cavity. These conditions of the Eustachian tubes and tympanum are so frequently the direct outcome of nasal catarrh that it is impossible to ignore the medication of this region in considering the treatment of ear symptoms. The two proceed together up to a certain point, and at the commencement of the ease treatment of the nasal-region usually demands precedence.

The salts of ammonia owe their adaptibility to the object in view to the physiological property which they possess of causing the peripheral vessels to contract their

calibre. Their influence in this respect is probably slighter than that of ammoniacal vapour, sufficiently diluted, for which reason I usually prefer the latter. The formula already quoted combines the advantages of both drugs, camphor and ammonia; its use may be commenced after the irrigating process with the douche or syringe has been carried out for a week or longer, and under these circumstances it gives satisfactory results, air then being readily forced into the tube with a Pollitzer bag.

The foregoing treatment is sufficient in recent cases to remove the deafness, and tinnitus.

Unfortunately patients seldom present themselves for treatment till the symptoms have persisted over a lengthened period, when cold after cold has added its fresh accretion of mischief. We have then to deal with the hypertrophic states of the submucous layers of tissue lining the regions implicated as well as with the superficial congestions. It is the chronic character of these poliferating processes, and the difficulty of getting at the recesses invaded by them, which constitute the chief obstacles to treatment.

Very usually patients of this class complain of *frontal headache*, accompanied with a sense of weight and tightness in this part of the head, as well as a general "stuffed up" feeling in the ears and nose. These symptoms are due to a participation in the congestive and hyperplastic processes by the tissues lining the frontal and sphenoidal sinuses. When the state thus described is superadded to the further symptoms of deafness, giddiness and loud buzzing in the ears, it will

be difficult to imagine a more pitiable object than is presented by such patients.

In treating these cases, I usually commence with a full dose of *calomel* repeated at intervals of two, or three nights according to circumstances. This proceeding will greatly facilitate the effect of subsequent measures, especially when the symptoms occur in plethoric females of lethargic temperament and sedentary habits. By whatever theory the action of the drug administered under these circumstances is explained, there can be no doubt of its influence in relieving the congested veins which impede the capillary circulation of the part affected. It is obviously useless to apply the spur to the dilated arterioles until the mechanical incubus presented by this venous engorgement has been removed. This it seems to me is the *rationalé* of exhibiting calomel in these cases; it has the practical value of affording relief to the distressing symptoms above enumerated.

These measures while relieving the coarser symptoms, will have but slight effect on the tinnitus, especially if this be of long standing; and for the reason that this symptom is related to the hyperplastic processes attending chronic congestion of the deeper layers of the muco-periosteal membrane lining the middle ear. Here *iodine*, in some of its combinations, is our sheet anchor. Just as we found the bromides related therapeutically to the vessel area of the vertebral artery, so will iodine be seen to have a correspondingly curative influence over the circulation of the middle ear. But it must be applied locally.

Iodide of potassium may be administered internally with steel, but this must not preclude its local use. For the latter purpose I prefer combining it with ammonia, a convenient formula for which is the following :

Tr. iodi. Comp. \mathfrak{z} j.

Sp. Ammon. Comp. \mathfrak{z} j. m.

\mathfrak{z} j in a pint of nearly-boiling water, the steam to be inhaled by the Valsalvan method.

The inhalation of the vapour of ammonium iodide in this way becomes very effective when following upon the previous treatment. By the Valsalvan method every recess can be penetrated, and mixed with steam, the vapour does not irritate. There is moreover this advantage about the proceeding, that the treatment can be pursued at home, so avoiding a daily visit to the aurist.

Besides those conditions which lead to, or perpetuate disease of the nose and post-nasal space already considered in the Chapter upon "Post-nasal Growths," there is the extensive class of simple *chronic catarrhs*, resulting for the most part from the influences of climate. Hypertrophy of the mucous tissues accompanied with excessive secretion is the common sequence of all such affections, and the frequent precursor of aural disease. These conditions must be dealt with previously to the direct attack upon the organs of hearing, if the latter is to be successfully carried out. Such a result will be best secured by the use of the nasal lotions already described, two or three times daily, with the view of removing incrustations, and decomposing secretions, which render the breath offensive, and cause the patient

much discomfort, besides keeping up irritation in their neighbourhood. The anterior nasal syringe with an almond-shaped vulcanite nozzle is, in my experience, the simplest and most efficacious method of accomplishing this object.

A chief obstacle to the treatment of post nasal disease arises from the difficulty of maintaining medications in contact with the part. To overcome this difficulty, and with the special object of reducing the swelling of the schneiderian membrane, I at first had recourse to short gum elastic bougies, the pressure of which, when introduced through the anterior meatus, exerts a favourable effect upon the congested tissue. I have latterly relinquished these, except in cases of distortion of the septum, or enlargement of the turbinated bones, in favour of *medicated cotton wool*, as it combines the advantage of affording support to the distended vessels, and also allows the topical medication of the region to be maintained, without inconvenience to the patient.

Since my first recourse to iodoformed wool some few years ago, I have gradually adopted cotton wool as a vehicle for almost every therapeutic agent required to be applied to the nasal region, and much prefer it to the snuffs, gelatine bougies, and other expedients, always excepting lotions, for the object contemplated. The following is my method of using it. In mild or comparatively recent cases, it is sufficient to pass a small pledget of the wool on a probe through the anterior meatus along the floor of the nose, to the spot where it is desired to leave it, withdrawing the probe

as soon as this is reached. No uneasiness to the patient is caused by the wool in the nasal passage, he is in fact unconscious of its presence. It may be discharged on blowing the nose, or sneezing, but will be certainly expelled on using the nasal syringe, which should usually be done about half an hour before introducing the wool.

In some chronic cases, and where the surface is ulcerated, in ozæna, or when the tissues lining the post-nasal space have to be dealt with, I adopt the following plan. The quantity of wool determined upon is twisted spindle shaped, but loosely, upon a piece of thread, the thin ends are brought together and knotted. Thus the spindle shaped pledget of wool is doubled on itself and secured firmly to the thread, having now a pear shape, the stalk being represented by the ends of the thread. A probe is engaged in the wool, and made to conduct it along the floor of the nose, as far backwards, or upwards, as may be necessary. The process being repeated on the other nostril, the threads from each are tied into a knot just below the nose, to secure the wool from passing down the pharynx. In the morning, supposing the application to be made over night, they can be withdrawn by pulling on the threads. If desired several such pledgets may be introduced one after the other, until a sufficient quantity has been placed *in situ*; the threads belonging to all can then be secured by tying together.

In this way any drug may be applied with ease, as by proper management almost any therapeutic agent can be diffused through the wool. The following

formulae are among the most useful, and have been prepared for me with great care by Mr. Bullock of Hanover Street.

IODOFORM WOOL.

- ℞ Cotton wool, grs. 70.
 Glycerine, ℥x.
 Alcohol (s. p. 796) 3 ij.
 Ether, (s. p. 730) 3 j, vel q. s.
 Iodoform, 3 j.

Dissolve the iodoform in the ether; add the glycerine mixed with the alcohol; saturate the wool with the above mixture; and dry by exposure.

PERCHLORIDE OF IRON WOOL.

- ℞ Cotton wool, 3 j.
 Glycerine, ℥x.
 Tr. perchlor. iron, 3 j.
 Saturate and dry as above.

TANNIN WOOL.

- ℞ Cotton wool, 3 j.
 Glycerine, ℥x.
 Tannin, 3 j.
 Alcohol, 3 vi.
 Saturate and dry.

CAMPHOR WOOL.

- ℞ Cotton wool, 3 j.
 Glycerine, ℥x.
 Æther (s. p. 720) 3 j.
 Saturate and dry.

HAMAMELIS WOOL.

- R Cotton wool, 3 j.
Glycerine, ℥x.
Tr. Hamamelis, 3 j.
Saturate and dry.

KINO, CATECHU OR RHATANY WOOL.

- R Cotton wool, 3 j.
Glycerine, ℥x.
Tr. Kino, 3 j.
Saturate and dry.

BORIC WOOL.

- R Cotton wool, 3 j.
Glycerine, ℥x.
Acid. boric, 3 j
Alcohol, 3 vi.
Saturate and dry.

ALUM WOOL.

- R Cotton wool, 3 j.
Glycerine, ℥x.
Alum, 3 ss.
Water, 3 j.
Saturate and dry.

OPIUM WOOL.

- R Cotton wool, 3 j.
Glycerine, ℥x.
Tr. opium, 3 ss.
Saturate and dry.

IODINE WOOL.

R Cotton wool, 3 j.
 Glycerine, ℥x.
 Tr. iodine, 3 ss.
 Saturate and dry.

CUBEBS WOOL.

R Cotton Wool, 3 j.
 Glycerine, ℥x.
 Tr. Cubebs, 3 j.
 Saturate and dry.

SALICYLATE OF SODA WOOL.

R Salicyl. soda, 3 ss.
 Glycerine, ℥iij.
 Water, 3 ij.
 Saturate and dry.
 Etc., Etc.

Of the preceding preparations, the Iron, Tannin, Hamamelis, Kino, Catechu, Rhatany, and Alum wools, are astringent or styptic; the camphor is stimulant; the boric astringent and disinfectant; iodine and iodoform, absorbent; the latter is also sedative, and is specially useful in syphilitic affections, and simple ulcerations of the nasal mucous membrane. The cubebs wool acts most satisfactorily in certain forms of chronic catarrh, in which also the salicylate of soda is of service.

Having by the means detailed secured a patent state of the Eustachian tubes, the next step consists in the

direct medication of the middle ear through the medium of access to it which these channels afford. By introducing the Eustachian catheter fluids can be injected through it into the tympanum. The disfavour in which this instrument is held by some aurists arises from the neglect to carry out the preliminary treatment of the naso-pharyngeal spaces just detailed before having recourse to the catheter, a neglect which can only result in disappointment to the practitioner, and be productive of much unnecessary pain to the patient. With due tact and delicacy, the introduction of the instrument along this sensitive mucous tract should be a painless procedure, but the most delicate manipulation will be intolerable to the patient unless the hyper-sensitiveness attendant upon its morbid condition be first reduced.

The most convenient arrangement for the introduction of medicaments to the internal ear is that devised by Weber-Liel, of Berlin, an illustrated account of which was published in the *Deutscher Klinik* for 1867. The essential element of this instrument is an inner elastic tube, longer than the catheter, which, when the latter is placed *in situ*, is passed on into the cavity of the drum, and to the outer orifice of which is attached a modification of Pravaz's syringe, previously charged with the fluid to be injected; a hand-ball bellows communicates with the apparatus, by pressure on which the instrument is first ascertained to be *in situ*: the piston of the syringe is then pressed down, after which a further blast from the bellows drives the fluid in the form of spray into the tympanic cavity. The medicaments which may thus be introduced will vary

according to the judgment of the surgeon and the nature of the case; they should be luke-warm and very weak. In the case of tinnitus due to hyperæmia of this region, I prefer the ammonium iodide, made thus; Tr. iodi ℥x, liq. ammon. fort, ℥v. aq. ʒj. Chloride of zinc gr. j—iv to ʒj may be also used with advantage. Where the presence of dried mucus is diagnosed, alkaline solutions are to be preferred, such as liq. potass. ℥v. aq. ʒj or somewhat stronger solutions of the bicarbonate of soda.

While efforts are thus directed to the medication of the middle ear and the naso-pharyngeal region, treatment will be advantageously addressed to the *drum-head* through the external meatus. If the membrane be entire the manubrium mallei is often, though not invariably, red and injected, as also are the plicæ semi-lunares. From what has been already stated respecting the continuity of the blood-vessels on either side of the drum-head, such a congested condition when visible from without is presumptive evidence of its extension to the tissues of the cavity. When the membrane is perforated the lining of the cavity will frequently be observed to be red and swollen.

In all such cases the topical use of astringents per meatum is indicated. Amongst this class of remedies the *nitrate of silver* has a pre-eminence that is quite distinctive. So striking have been its occasional results in the relief of tinnitus, having a tidal or wave-like character, that I have come to entertain the conviction that this drug exercises an anæsthetic influence on the nerves of the part, irrespective of its astringent action

on the vessels. If this inference be correct its adaptability for controlling the forms of tinnitus alluded to, will be readily understood, as it directs itself to antagonise the duplex origin to which the symptom has been already traced. Thus, while it diminishes congestion on the one hand, it soothes the sensitive nerves of the membrane on the other, to the irritation of which the reflex contraction of the tensor muscle has been already traced, and it will be remembered that this muscle-sound constitutes a very important element in the production of the noises in question.

The strength of the solution of nitrate of silver when thus employed will vary from grs. x to grs. xxx to $\frac{3}{4}$ j water, though I seldom find it needful to exceed the first-named proportions. It should be introduced *warm* into the meatus, a remark that is equally applicable to any fluid used in this way to the ear.

It usually happens that a temporary increase of deafness attends the employment of the nitrate, which disappears with the shedding of the superficial layer of cuticle destroyed by its application: the patient should, therefore, be prepared for this issue. As there usually exists some thickening of membrane from past attacks of myringitis, this condition is greatly diminished when the superficial layer has peeled off, after which the hearing power will be proportionately improved.

The application of solution of nitrate of silver to the drum-head is of further service in bracing up this membrane when relaxed by long continued depression. There is no doubt that this condition, *Relaxation of the membrana tympani* is a very real cause of ear symptoms

persisting after the conditions leading to it have been removed. Of this I have frequently satisfied myself, although Kramer disputed its existence, and some later writers are silent on the subject. It is found after prolonged displacement of the membrane, and consequent stretching of its fibres, which being inelastic do not return to their normal dimensions, when the causes producing the tension have disappeared. The loose and bulging condition which it still exhibits is attended with deafness and tinnitus, although these may be relieved temporarily when the membrane is distended by inflating the tympanic cavity. The symptoms attending this state will be much benefitted by the use of weak solutions of the nitrate (grs. iij.—v. to $\tilde{3}$ j.) applied to the drum-head daily for two or three weeks.

Sulphate of copper and perchloride of iron are occasionally of service, the latter especially when granulations are present. The latter may be used in the proportion of 3 j.—3 ij. to $\tilde{3}$ j. water. Should polypi exist they must of course be removed.

It is no part of the object of this treatise to discuss exhaustively the treatment to be pursued in every form of ear disease, but rather to direct attention to the removal of those objective conditions, to the presence of which the symptoms have been referred. Pursuing this plan there remains to be considered the means for rectifying certain *malpositions and adhesions of the drum-head* which are commonly associated with tinnitus and vertigo. It is necessary to premise that attempts to reinstate the *membranæ tympani* are frequently abortive because undertaken precipitately, and without

that preliminary treatment which is necessary to restore it first of all to as normal a condition as possible before attempting its reduction. Doubtless the accomplishment of the various ends in view in dealing with these chronic cases, will tax the patience of all concerned, but, acting on the principle of the gentle continuous treatment of the obstacles to be overcome, many cases will be found to yield which are now given up as hopeless, or dismissed after a few promiscuous assaults applied without reference to any definite principle of therapeutics.

Retraction of the membrana tympani is met with in every variety of degree, from a slight cupping of its disc to complete collapse, in which its lower segment rests upon the promontory on the inner wall of the tympanic cavity. In this latter situation it may contract adhesions which bind it to its abnormal situation. Further, the displacement of the membrane may be associated with other morbid states; such as alteration of its proper tissues either in the direction of thickening; congestion, usually most marked in the semi-lunar folds and handle of the malleus; thinning of its layers, which become harsh and dry; cicatricial bands and adhesions; perforations; or that special condition of the membrane may exist which has been described as pathognomonic of contraction of the tensor tympani muscle. Each of these conditions requires to be differentially diagnosed and appropriately treated, as its removal is essential to any successful attempt to re-instate the membrane in its normal plane.

The state of *collapse of the drumhead* may be due simply to obstruction of the Eustachian tubes, ac-

knowledging a catarrhal origin, or, as the effect of paresis of the tube muscles, and the consequent interference with the renewal of air to the cavity of the tympanum. In such a case the measures detailed for remedying this state of the tubes will suffice to get rid of it, and if this is followed by a few applications of the air douche from a Politzer's bag, the membrane will regain its normal site, especially if the patient be instructed to inflate the region occasionally by the Valsalvan method. Far more difficult to deal with are those forms of depressed membranes associated with complete stenosis of the Eustachian tube, or which are further complicated with contraction of the tensor muscles, or are due to cicatricial bands and adhesions. In extreme cases of this latter kind, the tympanic cavity may be all but obliterated, the long process of the incus behind the manubrium and the promontory below it being visible through the dry and atrophied membrane. The external auditory canal will then present a funnel-shaped ending lined with the more or less glistening membrane. In this depressed position, the membrane may contract adhesions to the internal wall of the tympanum, which render its replacement by ordinary means impossible. Finding suction by Siegel's exhausting speculum to be of little avail, I have introduced an instrument for use in these conditions which at least has the merit of being able to remedy them. It is called the *Pneumatic Tractor*. The principle on which it depends for its superiority over that of Siegel is, that the entire force which the exhausted receiver is capable of exerting upon the point

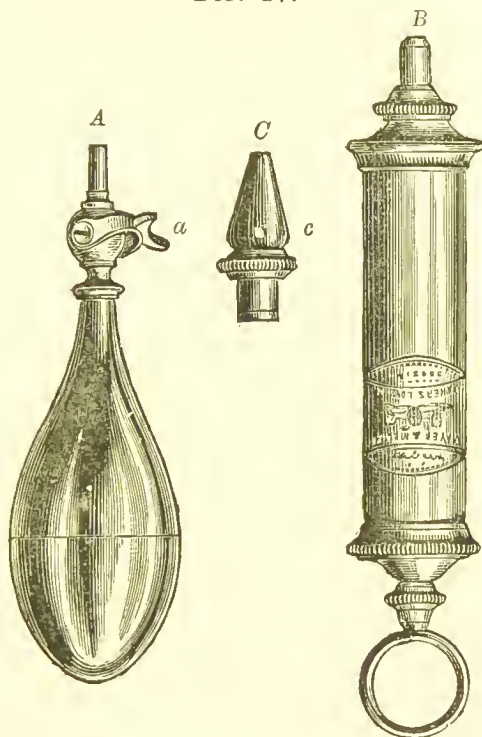
on which it acts, can be brought into operation at once, suddenly, and as it were by a stroke or *coup*. At the same time the operator has it in his power to apply the traction as gradually as he may desire. The amount of force used is also under his control, depending upon the extent to which the exhaustion of air from the apparatus is carried out previously to applying it; the decision of this point is a question of some delicacy and requires experience in the use of the instrument.

Description. The Pneumatic Tractor consists of three parts. A pear-shaped bell A, (Fig. 17), to which the exhausting syringe B fits. The bell is furnished with a stop-cock worked by a lever handle (*a*), C is a vulcanite ear-piece, shaped so as to fit the canal air-tight, which it is enabled to do by means of a short length of rubber tubing slipped over the small end. There is a hole (*c*) at the near end of the vulcanite ear-piece which is stopped by the forefinger when the instrument is applied, and by the removal of which, at any moment, air is admitted, when the traction ceases. By this means complete control is maintained over the instrument.

To prepare for use. Fit the exhausting syringe into the bell, and open the stop-cock—two or three movements of the piston will exhaust the bell sufficiently; then close the stop-cock and detach the syringe; in its place, put on the ear-piece, with the air-hole upwards.

To use the instrument. Introduce the ear-piece, with the tubing, into the meatus, and press gently but firmly into the canal, a proceeding which will be facilitated by first drawing the auricle upwards and outwards, then

FIG. 17.



close the hole (*c*) in the ear-piece with the forefinger of the left hand, and with the thumb of the same hand open the stop-cock by pressing sharply on the lever.

The effect will be evidenced to the operator by a sensation of dragging on the skin of the finger closing the air-hole, at the same time the patient experiences a similar sensation in the drumhead, which is usually unaccompanied with pain. The traction need not be kept up longer than about eight or ten seconds, and is ended by removing the finger from the hole, when air enters with an audible rush.

After a successful application of the tractor for ordinary degrees of depression, the membrana tympani will be seen on examination to have regained its normal plane, at the same time the effect of the suction will be evidenced by the injected state of the vessels of the membrane, especially of the manubrium and plicæ. This is of no consequence as it speedily subsides; it is an effect that follows almost any interference with the ear, the introduction of a speculum and the most gentle syringing being alike attended with this temporary congestion.

When pneumatic traction is used for the purpose of detaching adhesions, it is necessary to exhaust the bell more completely of air, when the suction will be greater; it is also necessary to turn the stop-cock quite suddenly on, by a more rapid movement of its handle than is otherwise required.

In such cases, indeed in all where it is possible to do so, some patency of the Eustachian tube should be secured, as the forward pressure of the column of air behind the membrane, when this is exposed to the suction of the vacuum, is an essential element in the success of the operation. Pressing equally in all directions, this column of air lifts the membrane from its adherent point as though it were pushed from behind by an air-cushion. When, as occasionally happens, the adhesion is so firm that the membrane is torn in the act of separation, the rupture takes the form of a slit-like rent, almost as clean as if cut with a knife. The sharply-defined character of the rent is mainly contributed by the pressure of the column of air behind

the membrane, derived through the ventilating shaft of the cavity. This perforation of the membrane is in every respect an advantage, as it allows the more ready medication of the tympanic cavity. It may, moreover, be kept open for a few weeks by the occasional re-application of the pneumatic suction, to just such an extent as causes the edges of the rent to gapc. By carefully following out this treatment, I have, in several instances succeeded in establishing a permanent opening, and with it a corresponding improvement of hearing power, while the noises and giddiness are proportionately diminished in nearly every instance where its employment is indicated.

The *precautions* necessary to be observed in using the pneumatic tractor may be briefly summarised as follows: It is of primary importance to establish a correct diagnosis, both as to the cause and extent of the existing depression, as the conclusions so arrived at indicate the degree of force necessary to restore it, and resultantly the extent to which the exhaustion of the bell is to be carried. Secondly, the patency of the Eustachian tube should be secured as a preliminary procedure. If the membrane be harsh and dry, and there are indications of adhesions, these must be softened by the external and internal use of alkaline injections, (see ante). Further, after this preliminary treatment has been carried out, it is necessary to proceed with caution. At the first a very slight degree of exhaustion, such as is implied by one stroke of the piston, should be employed, and, after each application, the membrane should be carefully examined to

judge of its effect. After this tentative proceeding, the degree of exhaustion may be gradually increased according to the judgment of the operator. The necessity for observing these precautions will sufficiently indicate the undesirability of entrusting this instrument to inexperienced hands, otherwise discredit will be thrown upon a really useful auxiliary to the armamentarium of the aurist.

A prolonged experience of this instrument has sufficed to show its entire harmlessness, and that the foregoing observations err, if at all, in excess of caution. Should, however, the operator prefer to see what he is doing, this can be arranged by attaching the exhausted bell to a Siegal's speculum, the ear-piece of the latter being first provided with the air hole for regulating the duration of the traction. It should be stated that whatever merits the author's instrument possesses, rest solely on its capacity for accomplishing certain objects; no claim has been advanced for it as having any specific curative power. It is and must remain an auxiliary to other measures, albeit a most effective one within the scope of its legitimate use.

The pneumatic tractor is made by Meyer and Meltzer of Great Portland Street, according to my instructions. An account of it appeared in the *Lancet* for September, 28th, 1878, in one of a series of articles written by the author, on the subject of "Noises in the Head," the substance of which has been embodied in this work.*

* Various modifications and uses of the pneumatic tractor suggest themselves as applicable to it. Thus, by a slight modification of the tubing of the ear-piece, it becomes available for the extraction of loose foreign bodies from the ear, such as seeds, beads, &c. Simi-

Puncture of the membrana tympani for the relief of noises and giddiness, has afforded but uncertain results in my experience. Occasionally, it is no doubt serviceable, as one amongst many other means of treatment, some of which it facilitates, such as the introduction of remedies into the middle ear. In recent catarrhal or purulent inflammations of the tympanum, recourse to this method is absolutely necessary. The reader is referred to the chapter on "Ear complications in the Exanthemata," for particulars respecting the method of operating, &c.

Nitrite of Amyl, as a remedy for tinnitus, is one, respecting which very conflicting evidence is offered. Its physiological effect, that of dilating the arterioles by paralysing their inhibitory (vaso-motor) nerves, would, on the hypothesis to which the more persistent noises have been referred in this treatise, contra-indicate its use. My own experience of the drug corresponds to this theory, for, out of the many cases in which I have used it, relief has only attended its administration in one or two. It is, however, necessary to state, that recently, Dr. Michael, of Hamburg, has adduced some 33 cases, in which considerable benefit accrued from its inhalation. When more accurate data exist, it will probably be found, that marked anæmia is present in those cases where the drug has proved serviceable, and that an anæmic bruit has existed concurrently with the tinnitus, of which it was the cause?

larly, by changing the action of the syringe, the bell becomes a reservoir for compressed air, which, by application to the Eustachian catheter, may be used for inflating the tympanic cavity.

Pulsating tinnitus, and its treatment by hydrobromic acid, has already been fully discussed in the early part of the preceding chapter.* It is only needful to repeat here the precaution already insisted upon, that to secure the complete success of this remedy, it is necessary to remove, by appropriate preliminary treatment, any complication of the labyrinthine congestion producing the symptom, which may be present at the time. Thus, post-nasal catarrh, obstructed Eustachian tubes, or congestion of the middle ear, must be first got rid of, and at the same time a healthy state of the meatus and external canal, with the drum-head, must be secured, before recourse is had to the remedy.

Some instances of failure with the hydrobromic treatment of simple pulsating tinnitus, have arisen from employing an imperfectly prepared or ineffective acid. Thus, a gentleman for whom I had prescribed the drug, experienced no benefit after taking it for a longer period than should have relieved the symptom, but was rapidly cured when a genuine preparation was taken. To avoid such disappointment, I have thought it desirable to append the correct formula for making it, which is as follows:—

FORMULA FOR PREPARING HYDROBROMIC ACID.

℞ Potas. Bromid. \mathfrak{z} x., 3 vi., grs. xxviii.

Water, ʒ lxxx., (4 pints).

dissolve and add

Acid Tartaric, ʒ xiii., ʒi., grs. xxxvii.

* See p. 136 *et seq.* The first notice of hypobromic acid for the cure of this form of tinnitus, was published by the author in the *Brit. Med. Jour.*, 1877.

The hydrobromic acid remains in solution and can be decanted from the cream of tartar precipitate.

The *Electric current* has been extolled by some authors as of universal efficacy in relieving tinnitus, while others decry it as useless. Its true therapeutic position will be found midway between these divergent estimates of its value.

Its utility will depend on the adaptation of the kind of current employed to the end to be accomplished. The electrolytic action of the constant current may be advantageously used for removing hyperplastic thickenings of the Eustachian tube and middle ear. Moreover, "it diminishes the excitability of the sensory nerves, it takes away abnormal stimuli from them, it modifies their nutrition, allays hyperæmia and inflammation" (Erb.), and thus adapts itself to fulfil most of the indications for the removal of the causes of tinnitus to which this symptom has been traced in the preceding pages. For all these purposes the constant current yields the most satisfactory results. On the other hand, cases occur in which there is an evident immobility of the conducting media, either from the ossicles being fixed in an abnormal position, the results of bygone mischief; or the intrinsic muscles having lost their power from disuse, or disease, fail to act on the levers they are designed to move. Under these circumstances slight shocks from the Faradic current should be employed to produce the requisite commotion in the adherent ossicles, or for the purpose of exciting muscular action. If the current be applied to the chorda tympani as it crosses the drum-head, the stapedæus muscle, the nerve to which

comes likewise from the 7th, will be called into action. In this way the base of the stapes will be eased in its position over the foramen ovale, and any pressure exerted by it on the labyrinth will be lessened. That this does actually occur is proved by the statement volunteered by patients while undergoing the process, to the effect that they experience sudden relief to the giddiness and sense of weight in the head which previously affected them.

In like manner the action of the tensor muscles will be reflexly excited by the application of the current to the surface of the membrane through the branches of the fifth supplying it; the channels of excitation in this case are indicated in Fig. 16, p. 155

For the application of either form of electricity a very simple appliance is requisite. A vulcanite Eustachian catheter is so prepared that it forms one electrode: for this purpose it is tipped with a ring of metal communicating by a wire along the inside of the tube to the metal ring or hook at the other end. To this latter, one pole of the battery is attached after the catheter has been introduced. Being hollow, the tube can be ascertained to be *in situ* by inflating in the usual way.

My electrode for the external auditory canal and drum-head, consists of a narrow vulcanite speculum traversed by a thin wire spiral, armed at the distal end with a small piece of sponge which projects beyond the speculum. At the opposite end the spiral terminates in a screw which works in a bar crossing the broad opening of the vulcanite tube. This arrangement allows the spiral to be advanced or withdrawn by

means of the screw after the speculum is introduced into the canal, while the elasticity of the wire coil tipped with sponge, effectually prevents undue pressure on the sensitive membrane. The other pole of the battery is attached to a ring at the outer end of the screw. By means of these appliances the electric current can be passed through the middle ear between the Eustachian meatus within, and the external opening of the auditory apparatus.

Two precautions should be observed in using electricity to the ear. The first is to employ a very weak current, a remark which applies to either form of electricity; and the second, to apply it at intervals of not less than a week. Failure to observe either of these conditions may be attended with an aggravation of the symptoms it is proposed to alleviate.

The best results of electricity are afforded in the treatment of "Paretic deafness," and in Weber-Liel's "Progressive deafness." For the methods of employing it in these forms of the disease, the reader is referred to Chapter IV. of this work.

CHAPTER IX.

SUPPLEMENTARY OBSERVATIONS ON THE CO-ORDINATING OR CORRELATING FUNCTIONS OF THE SYMPATHETIC GANGLIA, AND THEIR INFLUENCE IN DETERMINING THE SYMPTOMS OF DISEASE. HERPES. NEURALGIA. TROPHIC NERVES. ETC.

ALLUSION having repeatedly been made in the foregoing pages to the trophic tissue changes accruing from vessel dilatation, excited reflexly through the medium of vaso-motor impressions, I have thought it desirable to add these supplementary observations with the view of ascertaining what are the steps of this process, to which many of the phenomena already cited, have been referred.

Probably no more suggestive material exists on these points than that furnished by the records of cases of wounds and contusions of nerves, where the observer is presented with a direct vivisectional experiment, the results of which work themselves out with exceptional clearness. The comparison of these with other nerve lesions of idiopathic origin, but affording similar issues, will go some way towards supplying the desired information.

For the purposes of this comparison, seven cases recorded by Dr. Mitchell and his colleagues of the United States army will be briefly noted; as they closely resemble each other in their main features, it

will suffice to quote one only at length. It was in some of these where the brachial nerves were involved that the phenomenon of *falling* occurred. As this symptom was considered in the chapter on Giddiness, I shall confine these observations to the tissue metamorphoses following the injury.

David Schwely, æt. 17—shot in the neck at Gettysburg, *wounding the axillary nerves of right side*. Burning pain began on the tenth day in the palm and fingers of right hand. (This burning pain is an almost constant accompaniment of injury to a nerve.) Sensation in the limb was but little impaired. The joints became swollen and contracted. About a year and a half after receiving the wound the entire arm was shrunken, many muscles being represented by the mearest trace, and from their contracted state the wrist was partially dislocated. On the back of the hand from the knuckles to the finger-tips, the skin is tense, shining, hairless, mottled red and blue, abraded in spots; nails curved as in consumptive patients; joints swollen, tender; the whole palmar face of the hands and fingers is polished, deep scarlet, and eczematous. The eruption followed the burning in about six weeks; the palm of the left hand is almost equally eczematous, and began to be so nearly a month before the wounded side.

Case 19 is less marked. It records a *gun-shot wound of left brachial plexus*, with paralysis of motion, atrophy and contraction of numerous muscles; finger joints swollen and stiff.

Case 20 affords a striking parallel to one to be presently stated of an idiopathic origin. There was a

gunshot wound of both legs, with *injury of sciatic nerve*. Paralysis of flexors of foot, intense burning, ulcers about nails, congestion and eczema, but no thinning of the skin.

Case 21.—*Gun-shot wound of sciatic nerve*.—Partial paralysis of motion and sensation, burning pain, successive crops of eczema about every two weeks as high as knee, with relief to burning pain.

Case 22.—*Gun-shot wound of brachial nerve*.—Slight loss of motion and sensation, early burning pain, diseased joints, no eczema, but remarkably acid sweats. These disappeared during the electrization of the arm.

Cases 24 and 25 are similar, but do not require special detail.

The next cases are abridged from Sir James Paget's lecture in the *Medical Times and Gazette* of March 26, 1853, which contains probably the first reference to the symptoms under review. An epileptic patient consulted him a few years ago concerning the effect of an injury inflicted upon him by the tight application of a cord round the wrists and arms during an epileptic seizure. The immediate effect of this was to cause a dropping of the hands, like those of a patient with lead palsy. They then became cedematous and very painful. On the subsidence of this condition, the muscles of the forearm and hand were wasted, especially those of the ball of the thumb and little finger. The skin of the fingers afterwards became smooth and glossy, and the palmar cuticle peeled. It is not stated whether any rash existed. Recovery was gradual. Another case from the same lecture is simi-

lar:—A lady fell with her hands tied behind her, and in doing so forcibly withdrew one hand from the silk handkerchief which confined them, in order to save herself. This was followed by weakness and stiffness of the hand and numbness in the course of the distribution of the median nerve. After four or five weeks the back of the hand and fingers became hot, red, and glistening. The loss of power and defect of sensation in these cases left no doubt in Sir James Paget's mind of severe injury to the nerves of the forearm.

The following instance of an analogous state of things occurred in my own practice:—Some time in 1864, a child, aged twelve years, ran a thorn into the wrist on its anterior aspect, a few months before applying for relief. The site of the puncture was exactly over the *median nerve*. Since the accident the inner side of the arm, from the elbow downward had been numb, and a papular rash had existed in this locality during the greater part of the time. This completes the detail of all the cases illustrative of the traumatic form of the disease I had seen recorded at the time the facts were collected. Before passing to the other variety, it will be well to state that all the authors quoted agree that the phenomena in question are most marked where the nerve is partially injured only, and not completely destroyed.

Shingles being the typical form in which the association of neuralgia and skin rash occurs in its idiopathic aspect, I will briefly quote an instance of this kind, the counterpart of which will be familiar to every physician:—

Anne Smith, a married woman, æt. 47, who had

ceased to menstruate, was seen Oct. 22, 1866. She then had a bilateral crop of shingles developing below the mammæ and on the back: with it were associated loss of appetite, sleepless nights, and high-coloured urine; no pain. Ordered Liq. Potass. m. x. ter die.

Oct. 24.—Pain began to be felt in the line of the rash, of decidedly neuralgic character; “it catches her breath.”—Oct. 28. No better.—Nov. 2. Pain on left side, where the rash was most copious; very acute. A great tendency to faint. Ordered Ammon. Sesquicarb. gr. v., et Aq., \mathfrak{z} j. 4th horis; also Ferri Sesquioxidi, \mathfrak{z} ij, 4th horis.—Nov. 5. Eruption subsiding. Neuralgic pain relieved a good deal, but severe at night.—Nov. 7. Neuralgia worse on the left side. Ordered Ammon. Hydrochlor. gr. x., Ferri Sesquioxidi, 3j. 4th horis; also, Ext. Belladon., gr. $\frac{1}{4}$; 4th horis.—Nov. 9. Gets more relief from the latter than from any previous medicine. Pain is still severe, and she cannot lie down.—Nov. 14. Much better; sleeps well; pain gets less every day. Made rapid recovery. Alleviation most marked since addition of muriate of ammonia.

Were it necessary, such cases might be multiplied *ad infinitum*; but wishing simply to illustrate the prominent features of this disorder, I shall pass to other forms of it.

In the lecture already quoted, Sir James Paget speaks of *two cases of shingles affecting the arm*, in which neuralgia continued after the attack, and with it the fingers exhibited in a well-marked degree the features so often seen after injury of a nerve. That is to say, they became thin and tapering, smooth, hairless, glossy, pink,

and blotched, as if with permanent chilblains. These symptoms subsided slowly, being unaffected by the ordinary treatment of neuralgia.

The same author more recently reports in the *British Medical Journal*, Oct. 13, 1866, a case in which an analogous cycle of events occurred; but inasmuch as the nerve affected found its ultimate ramification in a different texture, in bone as well as skin, a further illustration was afforded, by varying the experiment, of the direction in which the morbid processes point. Very briefly abstracted, it is as follows:—A gentleman, after exposure to cold had *neuralgia in right side of face*. In three days an herpetic eruption set in, which coincided with the surface distribution of the infraorbital, anterior dental, and anterior palatine branches of the right superior maxillary nerve. The eruption extended to the right half of the roof of the mouth and adjacent part of gum and cheek. Subsequently necrosis of the alveolar border of the jaw occurred, the teeth of which fell out, and ultimately the bone itself came away. Complete recovery followed, but well-marked pitted scars, unlike the herpes of shingles, remained on the site of the eruption.

A case of *herpes of the glans* is reported in the same paper as occurring in a gentleman after every sexual intercourse with his wife; the result, says the author, of an excited unsound nerve force.

An instance of *herpes of brachial plexus* is reported by Dr. Broadbent, in the *British Medical Journal*, for Oct. 27, 1866. A woman, aged 74 years, after suffering with severe burning pain down right side of neck and

right arm, and herpetic rash extending from lower cervical vertebræ (corresponding to the distribution of the small posterior branches of the plexus) across the right side of the back of the neck, over the shoulder, and down the outer side of arm to the upper part of forearm on its outer aspect, for a week, lost the use of the arm. The burning pain remarkably resembled that described in the traumatic cases, and the almost general, but incomplete motor paralysis of the limb, still more closely allied it to these. The patient appears not to have benefited by treatment. This case supplies another link in the chain of phenomena; viz., the association in an idiopathic case, of paralysis of motor nerves, pain in sensory nerve, and cutaneous rash. A case of *neuralgia in leg* associated with ulcers (superficial), is reported by Mr. Hooker, in the *Lancet* for 1859, which was successfully treated by division of the popliteal nerve. After the operation the pain disappeared, and the ulcers healed. There is yet another case which I quote from memory, having recently read the details, but having lost sight of the author who records it. It is to this effect: A patient suffered for many years with neuralgic pain in the leg, complete wasting of the muscles, thinned and shiny skin. Whether any rash existed or not is doubtful. Every treatment was exhausted without effect, when the popliteal nerve was divided, the operation being followed by complete recovery.

If now we reduce the symptoms exhibited by the foregoing cases to a tabular form as under, they will all be seen to possess more or less of a substitutive charac-

ter, and further, there is no single phenomenon peculiar to any special form of the disease, whether idiopathic or traumatic in its origin. These are not subjective cases, nor are they to be explained by some ill-defined notion of a morbid state of the blood acting on the nerve centres, and reflected to the seat of the disease. Thus, glossy or atrophied skin, a typical feature of an extreme and long-continued degree of interference with the innervation of a limb, such as usually results from a direct wound of the nerve, is also found in company with idiopathic Herpes of the arm. The necrosis of the upper jaw in the case of facial Herpes and neuralgia, receives a parallel in the ulcerous patches of integument (a cutaneous necrosis) occurring with severe neuralgia of the leg. And though an apparent divergence is presented in the character of the rashes described, these are only varieties of the same type, and all own the same pathological cause. In fact, as will be shown farther on, the special character of the rash, is determined rather by the anatomical situation and arrangement of the set of vessels affected by the dilating process, than by any other factor instrumental in its production.

IDIOPATHIC.

Herpes Zoster	...	Neuralgia.	
„ Brachialis	...	„	...
„ „	...	„	...
„ Facialis	...	„	...
Ulcer of leg	...	„	...
Eczema of leg	...	„	...
			Glossy skin.
			Motor palsy.
			Necrosis of jaw.
			Cured by division of popliteal nerve.
			Glossy skin, cured by division of popliteal nerve.

TRAUMATIC.

Wounded median nerve ...	Numbness	Papular rash.
„ axillary nerve ...	Nouralgia, Palsy	Eczema, glossy skin.
„ sciatic nerve ...	„ „ ...	„	ulcers of nails.
„ brachial nerve ...	„ Œdema ...	„	ulcers, glossy skin.

The peculiar appearances which, for the sake of brevity, are classed under the head of “*glossy skin*,” and which mark the degenerative era of the affection, possess some very interesting connections. This is seen, *e.g.*, in the disease termed alopekia areata, which with its congener morphæa alba atrophica, appears to present features so closely allied to the skin complications of neuralgia, that their pathological analogy admits of little doubt, whatever difference of opinion may exist respecting the nature of their cause. The likeness will be recognized by any one who will consult Mr. Erasmus Wilson’s description of these diseases; and it is interesting to note that this intimate resemblance between glossy skin occurring directly from nerve injury and that arising spontaneously in the system, confirms the fact insisted on by Mr. Wilson, that the phenomena of area, at any rate, are due to atrophy of the skin, the result of defective innervation. But the phrase defective innervation requires further examination.—Can we get beyond the mere language and understand its mechanism?

In a very suggestive communication to the *British Medical Journal*, Oct. 13, 1866, Sir James Paget, remarking on these cases, says that “it has yet to be decided in what degrees and manners nutrition may be

affected by disturbance of nerve force." And again, in the *Medical Times and Gazette* already quoted, alluding to the pathology of the disease, he says: "It is evident that long-continued paralysis of both motion and sensation, attended with rapid wasting, and more or less of neuralgia, may ensue in consequence of such injury to nerve fibres, *as probably falls far short of rupture or destruction of their tissue*, and that these things, in an extreme degree, may be due to an injury which neither in the manner of occurrence, nor in any other attendant character, would seem to have fallen with special severity on the nerve trunks. It would seem as if the *nerve trunks might be rendered long incapable of their functions by such injury as when occurring to the brain or spinal cord, we call concussion*." Again, in the American work already laid under such liberal contribution, the authors say: "When a nerve is injured, the muscles may be paralysed, sensation destroyed, or nutrition attacked: these triple results will occasionally occur in one and the same case, but in different degrees, as motor, sensory or nutrient fibres happen to suffer more or less." And in seeking "for the mechanism by which the nutrient nerves act," they further say:—"Whether they are *sympathetic fibres*, as we believe them to be, and whether they produce effects directly on the tissues, or only through their *control over the vessels*, are points which our cases do not aid us to clear up, and for these reasons we decline to discuss them."

Whether the additional light derived from the comparison of the allied class of idiopathic cases will supply the missing links in the pathology of the traumatic

ones, and whether from this comparison a true deduction may be gained for the solution of Sir J. Paget's query, in what degrees and manners nutrition may be affected by disturbances of nerve force, are questions towards the solution of which the remainder of this chapter will be directed.

It is unnecessary to repeat here what has already been frequently stated concerning the constitution and functions of the vaso-motor nerves, to which system most of the phenomena referred to may be traced. The salient fact to be borne in mind is, that nearly all cerebro-spinal nerves contain fibres belonging to this system, which are afferent as regards their centre. Hence, when a spinal nerve is contused or receives any kind of shock, its sympathetic fibres participate in it equally with the sensory and motor cords. That while to the two latter belong the contractions of tendons, muscular twitchings, ("live blood"), and other spasmodic states, as well as the conditions of diminished or exalted sensitiveness—the immediate effect on the former is shown by the dilatation or contraction of the blood-vessels supplied to the region with which these afferent fibres are, through their respective ganglia, reflexly related.

Thus, it appears that afferent sympathetic fibres correspond, speaking generally, to the sensitive cords of spinal nerves, as they receive and conduct impulses to their respective ganglia or centres. The efferent sympathetic nerves correspond to motor cords of the spinal system as they end in muscle, though of the unstriped variety. There is this difference between the two systems, that while stimulating a sensitive spinal nerve

causes muscular contraction, stimulating the sensitive afferent cords of the sympathetic system produces muscle relaxation, and in the case of such as go to the coats of arteries, dilatation of their calibre, to the extent of enabling them to receive much more than their ordinary amount of blood.

That there are conditions in which a reflex stimulus results in contraction of the unstriped muscle, is abundantly evident from many examples: it results in diminution, extending even to obliteration of the calibre of the vessels concerned, with a corresponding starvation of tissue, atrophy or necrosis, as its consequences. The shining, thinned, and glossy skin, curving of nails, and wasting of muscles, seen amongst the later occurrences following contused nerves, are doubtless examples of atrophy resulting from vessel contraction, while the ulcers of the skin, a marked instance of which is afforded in Mr. Hooker's case, just quoted, shows the starving of the tissues from the same cause proceeding to the extent of actual necrosis.

That this contraction of vessel calibre is due to reflected nerve irritation, *i.e.*, that it does not imply simple mechanical stasis from engorgement, is obvious from the fact that there must exist continuity of afferent fibres to maintain it—for the symptoms cease when these are divided. The irritation being thus removed, the blood-vessels fill again, and resume their nutritional functions. This at least would seem to be the teaching of Mr. Hooker's case, in which the ulcers healed after division of the popliteal nerve. It is further confirmed by the observations of the American authors, to the effect

that all the phenomena resulting from nerve lesion, are most markedly developed when this amounts only to bruising of its fibres, and that they scarcely appear when division is complete.

Referring to the patient, the circulation of whose arms became affected as the result of shock originating in the stomach, (*vide* page 117 *et seq.*), we see a faint and temporary resemblance to the mottled and chilblain-like appearance of the hands, which is so persistent a symptom in the severer cases of traumatic shock. What in the milder case means loss of tone and temporary dilatation of the vessels, with consequent stagnation of blood in the part, becomes in the other a vessel paralysis, the duration of which is in proportion to the violence of the original lesion. The diagram, p. 115, indicates the channels whereby through nerve medium these results are accomplished in the latter as well as in the former instance. Thus, branches of communication are seen proceeding from the inferior cervical ganglion to the cords of the brachial plexus. These are the afferent channels conveying the shock (in the traumatic case) to the ganglion. The axillary plexus, furnished by the ganglion to the brachial vessels, supplies the efferent channels conveying the reflected impression to the distal limits of the circulation of the limb.

A corresponding line of argument will explain the congestive mottling of the forearms and hands associated with labyrinthine vertigo, the result of pressure exercised from within the middle ear, and which is discussed at page 121 *et seq.*

As regards the crops of vesicles—the herpetic and

eczematous rashes which appear in these distal regions—they are phenomena that attend the accession of blood to an artery whose final distribution is in the special structures of the skin. Thus, *e.g.*, the capillaries distributed to the papillæ of a given area when so distended, permit of serous effusion through their walls, and a consequent watery elevation of the cuticle covering them, which, as its bulk increases, becomes a vesicle. It is probable that variations in the character of the rash—whether herpes or eczema predominate—has reference mainly to the mechanical arrangement of the set of vessels involved in the process. While if the distension affect more deeply-seated portions of the circulation, œdema of the subcutaneous tissues will result from the effusion. Obviously, all these conditions may exist at the same time, or be variously combined.

Mutatis mutandis, the same explanation holds good with regard to idiopathic herpes, shingles, &c. The usual sites of the eruption are those which are liable to be exposed to violent impressions, especially from cold, such as the face, the trunk where there is usually a division in the wearing apparel, and again in herpes præputii arising under the circumstances stated above. I can recall several cases where the causes was distinctly recognisable. Such as, an attack of shingles occurring 4 days after the subject had endured for several hours the pressure of a new and tightly fitting pair of stays: another in which the eruption came on after stripping to the waist and washing in a cold room: a third in a child, where a dense streak of herpes fol-

lowed a journey in an open vehicle, during which, by the accidental displacement of its short skirts, the child's waist was subjected to exposure to a cold wind. Of a similar character are five cases reported by Dr. W. H. Day* who appends this significant comment: "all the cases happened at a cold time of the year," one of these, No. iv. in its accompaniments of skin infiltration and discoloration, presented appearances closely allying it with those of a traumatic origin just considered.

As regards *causation*, I have traced the cycle of events too frequently to render it needful to dwell on them here. The afferent vaso-motor fibres accompanying the spinal nerves to the skin, receive the shock and conduct it to a sympathetic ganglion, usually in *zona* an intra-thoracic one, whence it passes by the efferent nerves distributed to an artery—in this case one of the intercostals, as a wave of vessel dilatation. This if sufficiently severe means herpes, as far as its cutaneous distribution is concerned, and *neuralgia* as regards those of its branches which supply the intercostal nerves—*vasi nervorum*.

Those who have followed my argument thus far, will, I think, perceive that the congested extremities and weary aching arms in the case where the impression originated in stomach lesion, is only a less degree of the same phenomena, which in *zona* has passed into the next stage—that of effusion, implying herpes on the skin, and neuralgia from stretching and pressure,

* *Jour. of Cut. Med.*, Oct. 1867.

exerted by the fluid extravasated within the sheath of a nerve containing sentient fibres.

Many circumstances will add to the severity and enduring character of the pain thus associated with herpes. In the first place the patient is usually debilitated or broken down in health, a state of things implying that mobility of the vaso-motor centres, without which the cycle of events under review would not happen—though the influence of heredity briefly alluded to on a former page, may be sufficient to account for this. Then, he may be the subject of some constitutional cachexia, the specific elements of which, as in gout, rheumatism, &c., accompany the effusion into the nerve sheath, and add their quatum of irritation to that which would otherwise be due to mechanical causes only. Or, the more solid elements of the blood, hæmorrhage in fact, which sometimes takes place in the vesicles, may similarly happen within the nerve sheath, in which case it is obvious that pain resulting from its presence would be both obstinate and severe.

This theory of suspended inhibition and consequent vessel-distension in given regions, whose limits are mapped out by the efferent or vessel-nerves of a particular sympathetic ganglion, seems to me quite competent to explain the phenomena of *periodic neuralgia*, happening altogether apart from malarial influences, but usually seen in cachectic subjects. In such cases the dilating wave occurs as a condition of used-up nerve-force, the vessel equilibrium maintained up to the time of commencement of pain having exhausted the supply of nerve-energy necessary to support it.

Vessel-relaxation follows where the mobility of a ganglionic centre is greatest, with the consequent distension and stretching of sentient tissues indicated. All of which conditions cease when sufficient force has again collected to enable the inhibitory centre to reassert its control over the vessels in the disturbed area. With this re-establishment of the normal calibre of the arterioles, the pain intermits.*

Here it is necessary to insist on the essential part played by the *ganglia* in this rôle of events, they being the co-ordinating media determining, by the relationships of their afferent and efferent febrillæ, the exact region which shall exhibit the reflected tissue metamorphoses. But they have another and wider action, due likewise to the anatomical communication of nerves which join them from distant regions, and which thus bring internal organs, especially the intestinal mucous tract, within the sphere of their influence. In this way there is established very intimate relationships between, *e.g.*, the skin, and visceral mucous membranes, so that morbid processes going on in the latter, have their counterpart in regions of the skin often very remotely situated from them; or, the proceeding may be reversed. It is this function which I have spoken of as the "correlating" function of the ganglia. The valuable observations recently made on "Surface Ther-

* The practical result of this aspect of the association of herpes and neuralgia, was the suggestion by the Author of the use of ergot for the relief of the pain accompanying shingles, in a paper read at the meeting of the British Medical Association at Oxford, August, 1868, and published in the *Brit. Med. Jour.*, Oct. 3, 1868.

mometry," more especially those by Dr. W. Squire,* in which the temperature of a circumscribed tract of skin was raised, co-incidentally with a limited visceral inflammation, will be found to depend upon this correlating function. In the chapter on Vertigo certain other examples of the kind, dominated by the inferior cervical ganglion, were introduced. In these it was seen that the vessel-calibre of such a remotely seated organ as the labyrinth, was influenced by special lesions of the stomach on the one hand, and of the arms on the other, through the medium of the nerves which come as it were to a focus in this sub-centre.

The wide import of this correlating function extends beyond the sphere of the present subject; it must be dismissed, therefore, with the brief references already made to it.

Briefly summarised, these reflexly excited processes consist first in suspension of tone in the vessels, followed by such an accession of blood as distends them enormously beyond their wont, and causes pain where the situation favours its occurrence. This engorgement, if sufficiently persistent, is succeeded by effusion, the dilated state of the vessel-walls being exactly that which would allow first of serous exudation, and afterwards of the migration of cell-elements. If the effusion be upon a free surface therefore, its serous, purulent or mucopurulent character, becomes a question of duration and locality. If the situation be more confined, proliferation will be apt to ensue with hyperplastic results, the more

* *Vide Practitioner*, Nov., 1878.

fluid portions becoming absorbed. If there be present in the blood matter foreign to it, as when some morbid diathesis exists, *e.g.*, the rheumatic, gouty, or syphilitic, these will be likely to escape also, and add a specific character to the proceeding.

In view of these considerations, we may concede a certain amount of justification to those French writers who see an herpetic eruption in every phase of congestion, especially when occurring in mucous membranes.

Further, it would seem that this subject has a direct bearing on the vexed question of the existence of "*trophic nerves*," the variations of nutrition,—mal-nutrition, a-nutrition, or its excess,—coming alike under the operation of the mechanism now briefly sketched. While the metastatic changes of location to which the theory of correlated nerve tracts affords the clue, include still other trophic processes for the explanation of which this mechanism suffices. To search therefore for other and as yet unrecognisable means of accomplishing in the economy, that for which a method is ready to hand, would seem a work of supererogation. The more so as the amplification of the indications to which attention has been directed in the preceding studies, appears capable of supplying the missing links, whereby to explain many obscure occurrences alike in health and disease.

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